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October 1958

THE ECONOMICS OF IRRIGATION IN THE EASTERN UNITED STATES

A List of Annotated References

Library List

No. 66

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PREFACE

This bibliography is limited to irrigation in the 31 Eastern States, where more or less humid conditions prevail, and where irrigation is a fairly recent innovation. The concern is chiefly with returns from irrigation, as measured in crop yields and quality, compared to costs. Costs cover all phases of operation, from preparation of land and development of water sources, to equipment, labor, power, and harvest expenses. Water rights, when they constitute an element in cost consideration, are included, as is frequency of drought as a deciding factor in the need for supplemental irrigation.

The bibliography is classified according to regions as outlined on the accompanying map, and there is a combined subject-author index.

Grateful acknowledgment is made of the guidance in defining the scope of the bibliography by Elco L. Greenshields, Land and Water Research Branch, Farm Economics Research Division, Agricultural Research Service, and by Robert L. Tontz, formerly of the Farm Economics Research Division, Agricultural Research Service.

Abbreviations of the publications cited are explained on pages 582-614 of U. S. Department of Agriculture Miscellaneous Publication 765, July 1958. Call numbers following the citations are those used in the Library of the U. S. Department of Agriculture.

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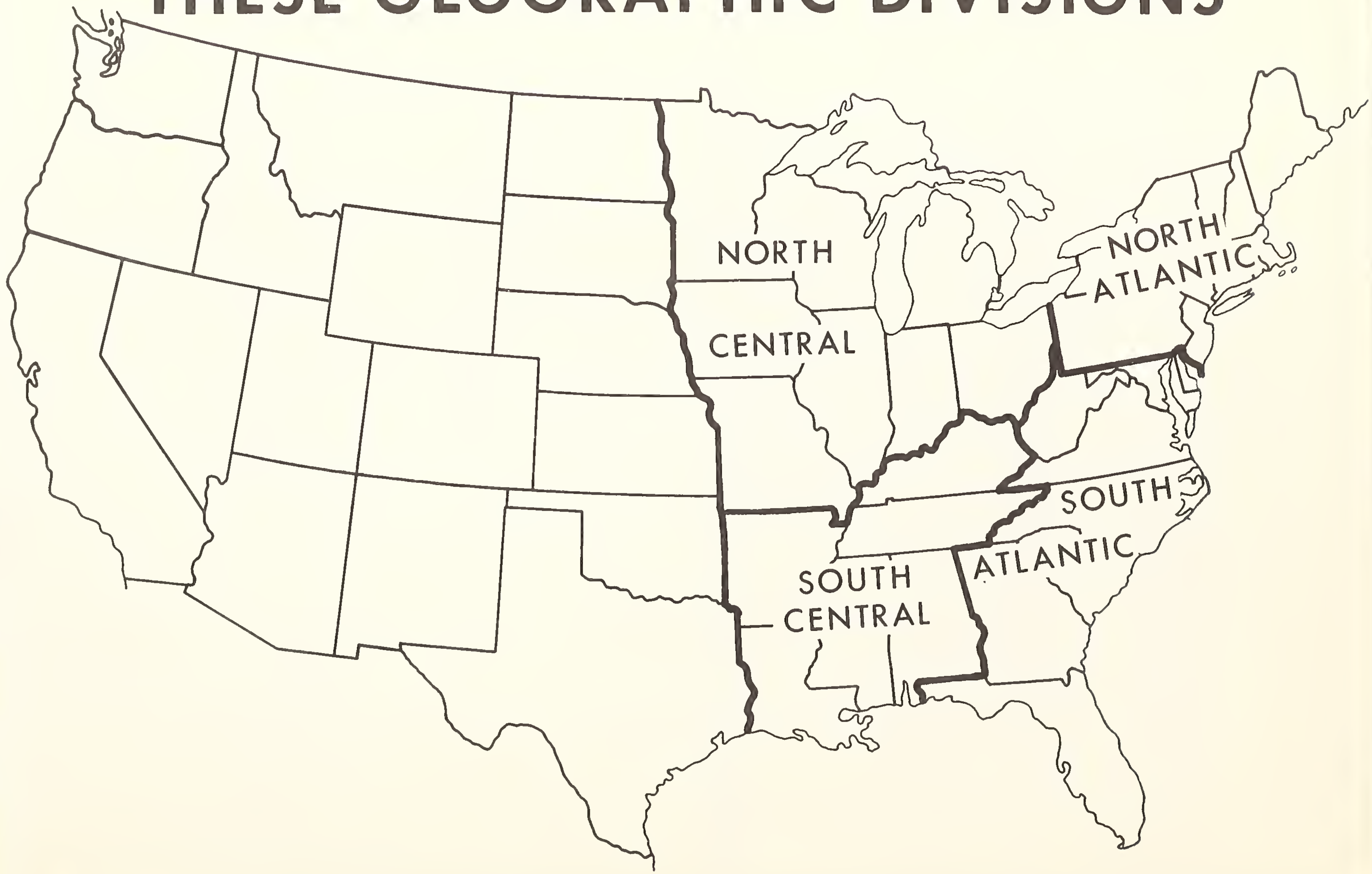

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THE ECONOMICS OF IRRIGATION IN THE UNITED STATES

A List of Annotated References, 1950-1957

Compiled by
Elizabeth Gould Davis and Edna S. Suber, Bibiliography Division, Library
and Wayne F. Ehlers, Farm Economics Research Division, Agricultural Research Service

GENERAL

1. ABELL, C. How to finance an irrigation system. Butane-Propane News 17(4):33-35. Apr.1955. 309.8 B97

Credit for installation of irrigation systems is available from irrigation equipment dealers, local banks, insurance companies, Production Credit Associations, National Farm Loan Associations, and Farmers Home Administration. Public Law 597 has increased the funds available to the latter for irrigation loans.

2. ABELL, C. North, South, East, West—irrigation is crop insurance. Butane-Propane News 17(2):27-31. Feb.1955. 309.8 B97

A study of 22 years of weather records in Mississippi shows 37 damaging droughts at Poplarville and 81 droughts at Stoneville at the Delta station. A farmer in Mississippi averaged 122 bu. per acre from irrigated corn and 24 bu. where it was not irrigated. Eighty acres of irrigated pasture supplied the feed that would have required 400 acres without irrigation. A Massachusetts dairyman received 78 additional days of grazing from his irrigated pasture. Georgia reports an increase of 111 percent in cow days of grazing after irrigation. An Illinois tomato grower reports yields of 16 tons with irrigation and 9 tons without. A Michigan strawberry grower produced 428 crates per acre with irrigation and 275 crates without. Cotton yields at the Arkansas Experiment Station increased 35 percent with irrigation. Georgia increased cotton yields from 766 to 2,569 lb. of seed cotton per acre with irrigation in 1952. A 1951 survey in Kentucky reports yields of tobacco of 2,081 lb. per acre at \$.614 per lb. for irrigated and 1,493 lb. at \$.549 for the unirrigated tobacco. Florida reports a 40-percent higher return and North Carolina a 53-percent increase in return from irrigated tobacco. Georgia reports an increase for snap beans from 541 to 5,184 lb. per acre when irrigated. Arkansas boosted sweetpotato yields from 336 to 626 bu. per acre with irrigation.

3. ALLEN, C. S. A water facilities program for the 31 Eastern States. Washington,U. S. Farmers Home Admin.,1955. 10 p. A282.9 AL5

Talk before the Southeast Section of the American Society of Agricultural Engineers at Louisville, Ky., Feb. 7, 1955.

Irrigation problems and what is being done, with special attention to the problem of adequate financing and soil and water conservation loans administered by the Farmers Home Administration.

4. ALLRED, E. R., and BLAKE, G. R. If you irrigate--how can you tell when? Minn. Farm & Home Sci. 13(3):18-19. May 1956. 100 M668

Comparisons are made of the relative merits of several soil-moisture-measuring instruments, including soil tube, tensiometers, gypsum and other blocks, and "feel test". Recently an atomic-radiation method has been developed using neutrons. It is very rapid but is unsuited for routine farm use.

5. ALLRED, E. R., and POMROY, J. H. Introducing fertilizer solutions into high-pressure irrigation systems. Agr. Engin. 35:171-172,178. Mar.1954. 58.8 Ag83

A very inexpensive system of introducing liquid or water-soluble fertilizers into sprinkler-irrigation systems can be made in most farm shops. It consists of a water-pressure tank and the necessary valves and pipe fittings to connect to the main line of the sprinkler system between the pump and the sprinklers. Only a very small flow of 1.5 to 2 gal. per minute is needed through the fertilizer line to empty the tank in about 30 minutes.

6. ALUMINUM COMPANY OF AMERICA. Portable sprinkler irrigation pipelines to profit with Alcoa aluminum. Pittsburgh,1951. 24 p. 55 AL8

A very brief summary of sprinkler irrigation in the United States showing requirements, costs, returns, crops irrigated, and when to irrigate.

7. AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS. COMMITTEE ON SPRINKLER IRRIGATION RESEARCH. Irrigation research in the United States and Canada in 1955. Report by E. H. Kidder. Saint Joseph, Mich.,1957. 102 p. 55 Am33

Report of a questionnaire sent to colleges, universities, and the departments of agriculture of the United States and Canada. A brief outline is given for each area showing project titles, location, description, objectives, results, and publications.

8. ARNOLD, E. L. Using electricity to water your garden. U. S. D. A. Farmers' B. 2044, 22 p. 1952. 1 Ag84F

Gives costs and returns for watering a small 90- by 120-ft. vegetable garden. Costs of pipe from the barn or house, frostproof hydrant, garden hose, rotary sprinkler, and sprinkler stand, would amount to \$77.35. Operating costs will come to \$5 per year, and depreciation on the equipment will be about \$5.80 per year, a total annual cost of \$10.80. Irrigation will increase the value of the vegetable crop from \$50 to \$75. Deducting \$10.80 from the gross increase of \$25 leaves a net annual return of \$14.20, an 18 percent return on the original investment.

9. AUTREY, K. M., and CANIFF, J. Comparative yields from irrigated and unirrigated pasture. (Abs.) Assoc. South. Agr. Workers Proc. 47:184-185. 1950. 4 C82

"A Ladino-clover-pasture-irrigation study was conducted in the summer of 1949. Alternate plots of this clover were irrigated and Jersey heifers were grazed on these plots from May to October. The irrigated plots yielded sufficient forage for 393 heifer-grazing days per acre. This was 44 percent more grazing than was provided by unirrigated plots. The animals on both irrigated and unirrigated pasture made normal growth rate."

10. BAKER, E. Electric irrigation systems. Rur. Kentuckian 6(4):14-15. Apr.1953. 385.8 K41

The advantages of electric over engine-driven systems are: 1, Lower maintenance costs; 2, lower operating costs, because the electric motor operates at 80 percent efficiency compared to about 60 percent for fuel engines, and because the cost of electricity runs about half the cost of fuel; 3, greater convenience for the farmer; 4, lower original investment; 5, simple and easy protection. Irrigation in Kentucky is especially suitable to high-cash crops such as vegetables and tobacco, and for dairy pastures.

11. BAKER, M. S. Over head irrigation. Sugar J. 13(5):50-52. Oct.1950. 65.8 Su391
Eighty acres of sugarcane were irrigated in 1948 in Puerto Rico by means of overhead sprinklers. All the pipe was laid underground at a depth of 44 in. Risers were about 375 ft. apart and each of the 2 sprinkler heads used covered about 2.5 acres at one time. Tests of the efficiency of the system showed it to be about 77 percent efficient as compared to about 50 percent for gravity flooding systems. This field had been yielding in the past about 20 to 25 tons of sugarcane. With irrigation by sprinklers the yield was 46.23 tons of sugarcane or 5.788 tons of sugar. Surrounding fields yielded about 9 tons less of sugarcane.

12. BALL, C. E. Easier ways to irrigate. Farm J. 79(2):36-37,163. Feb.1955. 6 F2212
Photographs and descriptions of shortcuts in moving irrigation equipment, such as pipe hooks, tractor-carrying attachments, and self-propelled rigs. A few costs are given.

13. BALL, C. E. Irrigation pays. Farm & Ranch-South. Agr. 80(6):12-13. June 1950. 6 T31
Farmers of various States discuss the results of irrigation. Arkansas: A furrow system costing $100 produced 1,200 gal. of syrup from 3 1/2 acres of cane, for a total increase in profit of $1,500. Georgia: In a region where unirrigated fields yielded 1,600 lb. per acre for a profit of $3,300, a $1,200 system on a sweetpotato field increased yield by 40 percent and increased proportion of No. 1 grade potatoes by 80 percent. Mississippi: A $1,260 sprinkler system increased the yield of corn to 119 bu. per acre. Tennessee: Irrigation of 100 acres of pasture increased dairy profits by $3,000 per year in milk alone. Irrigation of a 32-acre cabbage field increased yield 33 percent, or $75 per acre. North Carolina: A $1,770 investment in a sprinkler system saved a depleted pasture on a dairy farm and restored it to year-round grazing use.

14. BANTA, E. S. Plan before you invest. Amer. Fruit Grower 75(6):38-40. June 1955. 80 G85
If your irrigation-water source is a farm pond, enough storage should be provided for about 1 to 1 1/4 acre-feet per acre to be irrigated. General rules and observations on irrigation are given.

15. BARLOWE, R. We need water rights for humid-area irrigators. Farm Policy Forum 3(9):17-18. Sept. 1950. 281.8 F2274
The legal rights of farmers to take water for irrigation purposes have not been clarified by the courts in all the humid-area States. The courts have not recognized irrigation as a legal riparian use of surface waters; thus an irrigator is subject to court injunctions issued at the demand of other riparian water users. As there is no legislation which defines an irrigator's rights, he can be prevented from using water for irrigation when the practice interferes with other riparian users. If irrigation is to expand in humid areas, more attention must be given to the legal rights of the irrigator.

16. BEAR, F. E. Irrigation isn't the only answer. N. Y. State Hort. Soc. Proc. 101:187-189. 1956. 81 N484
In 1949, 1.5 million acres were being irrigated in the 31 Eastern States. Most of this irrigation was on the sandy soils of the Atlantic coast, from Massachusetts to Florida. The heavier soils of the inland States do not need supplemental irrigation so much as they need proper management to hold the 25 to 60 in. of rainfall per year, and to prevent runoff. Mulching, use of soil conditioners, and tool-bar cultivation are some of the practices recommended as less expensive substitutes for irrigation on these heavy soils.

17. BEDINGFIELD, C. H. The FHA plan for financing irrigation systems. Ala. Polytech. Inst. Agr. Ext. C. 485:35-36. Aug.1955. 275.29 AL1C
Outlines the loan provisions and eligibility requirements under P. L. 597 (83d Cong.).

18. BELLAMY, J. W. How can we improve our intermediate-term loans? Natl. Agr. Credit Conf. Proc. 1954:27-30. 284.29 N21
The 26.5 million acres irrigated in the United States represent an investment of $1,900 million in irrigation facilities. Irrigation requires a sizable investment by the individual farmer, and therefore easy credit should be readily available. An example is given of 566 acres of corn, cotton, and soybeans irrigated in Arkansas by flooding that required total costs of $5,802.16 or $10.24 per acre for the year. This cost included depreciation on the wells and equipment.

19. BENFORD, H. Why the South is turning to irrigation. Prog. Farmer, Tex. Ed. 68(2):48,50. Feb.1953. 6 T311
The 1952 drought has prompted many farmers to turn to irrigation. In Arkansas irrigated cotton averaged 1 1/4 bales, while unirrigated averaged about 1/2 to 2/3 bales. A corngrower in South Carolina has produced over 100 bu. of corn on an irrigated field compared to a rather poor silage crop on unirrigated land. In Virginia a tobacco grower made 1,942 lb. per acre which brought $.575 per pound. His unirrigated tobacco made 1,521 lb. and brought $.48 per pound. A Georgia vegetable grower reports yields doubled for turnip greens. Pasture irrigation has probably increased faster than any other. An Alabama dairyman reports 40 acres of pasture saved from burning up completely. In addition he saved from $15 to $18 a day in hay and feed from Sept. 15 through the fall. In 1950 a Georgia survey showed 225 farmers irrigating about 5,000 acres; in 1951 this had increased to 350 farmers irrigating 9,500 acres; and in 1952 the increase was from 50 percent to 75 percent over 1951.

20. BENNETT, H. H. The use of water in humid areas. Soil Conserv. 17:99-103. Dec.1951. 1.6 So3S
Examples of irrigation under humid conditions in South Carolina, Florida, Alabama, and Rhode Island are briefly mentioned. In 1950 a Rhode Island farmer's hay production increased 25 percent, or 1 ton per acre with irrigation. The Alabama Agricultural Experiment Station, Auburn, reported that in 1950 a sprinkler-irrigated plot produced 101 bu. of corn per acre as compared with 49 bu. per acre on a nonirrigated check plot.

21. BENNION, N. L. Irrigated pastures for turkeys. Turkey World 28(7):17,45. July 1953. 47.38 T84
Range feeding of turkeys saves 10 percent to 15 percent of the $4.50 per 100 lb. of feed it takes to bring 1 turkey to marketable weight. Irrigated pastures will graze from 100 to 200 birds per acre. Therefore a saving of from $.45 to $.67 per bird, or $45 to $135 per acre could be effected by irrigated pasture. In addition to the feed savings the turkeys provided an estimated $75 of fertilizer to the pasture in the form of manure.

22. BENNISON, E. W. How to determine requirements for pump irrigation. Impl. & Tractor 72(4):28-32. Feb.23,1957. 58.8 W41
Items to be taken into consideration in determining the requisite size of a pumping plant for sprinkler irrigation are: 1, The source of water; 2, total water requirements; 3, water losses; and 4, pump and power-unit efficiency. With the advent of lightweight, quick-coupling aluminum pipe, sprinkler irrigation has become less expensive to operate, and hence more popular in the Eastern States. Despite the higher initial cost, sprinkler irrigation is more economical than surface irrigation because it obviates the necessity for land leveling, it eliminates washing away of the topsoil, there is no loss of water, and it makes better use of a smaller amount of water.

23. BLACK, A. P. The water resources of the South. La. U. Engin. Expt. Sta. B. 55:48-66. 1956. 290.9 L9312B
The average per capita use of water in this country is about 2,000 tons per year, whereas all of our other requirements of food, fuel, materials, etc., total only about

18 tons. Our total present water use is only about 14 percent of that available. In 1900 the average per capita use of water was 88 gal. per day, and in 1950 it was 138 gal. This is an increase of about 1 gal. per person per day per year, so that the estimated use in 1975 will be 155 gal. In general the South is blessed with ample supplies of water for the foreseeable future. Use of supplemental irrigation in Florida is expanding very rapidly. Industrial use and salt-water conversion are also discussed.

24. BOUWER, H., and HELMS, J. O. Flexible tubing in sprinkler irrigation. Agr. Engin. 38(11):794-799. Nov.1957. 58.8 Ag83
Flexible tubing was used in an experimental sprinkler system in the form of branched flexible laterals. The labor requirements with branched flexible and branched aluminum laterals for irrigation of tall corn were .4 and .6 man-hours per acre per irrigation respectively, as compared with 1 man-hour with a hand-move aluminum lateral. Flexible laterals required a moving time of .7 man-hours per irrigation per acre in pasture. The use of flexible tubing also eliminated the need for carrying metal lateral pipe, and reduced the walking distance for moving sprinklers. Results of the experiment indicate that suitable flexible tubing may improve the labor aspects of irrigation with portable sprinklers.

25. BOYNTON, F. W., and MACAULEY, J. W. Pipes of aluminum make irrigation practical and profitable. Farm Equip. Retailing 15(3):24,26. Mar.1953. 58.8 F2292
Sprinkler irrigation dates from around 1900, and the early systems were permanently installed. About 1930 portable systems were available, but were not popular because of the weight of the iron and steel pipe. When aluminum pipe appeared on the market in 1948, portable sprinkler irrigation became general in the East.

26. BRADLEY, G. A. Studies on the irrigation of potatoes, onions and snap beans. Diss. Abs. 15:925-926. June 1955. 241.8 M58
Potatoes, onions, and snap beans were grown under field conditions over 3 years and irrigated at different levels of available soil moisture from 50 percent downward. All three crops showed a direct relationship of yield to available moisture at the time of irrigation. Indications are that it is desirable to maintain available moisture at or above the 50 percent level. Yield increases are obtained by both increased size and better set of tubers and beans. With onions it was size alone, as the stands were uniform in all plots. Additional plots of potatoes had 5 levels of moisture and 3 levels of nitrogen fertilizer under observation. The higher moisture levels resulted in earlier tuber set, greater tuber weight, and increased top growth. The higher nitrogen levels produced greater top weight but had little or no effect on number of tubers.

27. BROWN, D. Delta farmer scorns electricity, picks LPG for irrigation pumping. Butane-Propane News 17(2):137-140. Feb.1955. 309.8 B97
L.P. gas is rather widely used by growers as fuel for engines used in irrigation. Operating costs are about the same as for electric motors but L.P. engines have greater flexibility than electric systems and have no standby charges when not in use. Cotton yields were doubled with irrigation, and pasture yields for 3 summer months were increased from 1 head for about 6 2/3 acres to 3 head per acre with irrigation.

28. BRYAN, B. B. Electrical units for timing irrigations. Ark. Farm Res. 6(2):5. Summer 1957. 100 Ar42F
Comparisons of soil moisture from samples and from readings on electrical-resistance equipment indicate that electrical equipment is not reliable for farm-size fields but appears to give reliable results for small plots where accurate quantitative measurements of soil moisture are not required. Indicated soil-moisture contents were always higher than those obtained from soil samples in the plot.

29. BUTLER, C. C. Check your water rights before you invest in irrigation. Amer. Fruit Grower. West. Ed. 77(6):20,22. June 1957. 80 G85W
Irrigation-water demands are increasing rapidly, particularly in the 31 humid States, where about 3,000,000 acres are irrigated annually. Water rights in these States are not as well defined as in the dry States of the West, being based mainly on common law, or on individual court decisions. Farmers in the East must do everything possible to protect their irrigation investment by making certain of their water rights before installing the system.

30. CAROLUS, R. L. Irrigation does all this for you. Amer. Veg. Grower 1(8):7-8,16. Aug.1953. 80 C733
Quality, germination, and fertilizer efficiency are improved by irrigation in the humid East. For improved quality, irrigation hastens maturity and increases the rate and uniformity of growth of vegetable crops, increases the number and size of fruits and berries, regulates the size of potatoes, and promotes good pod fill in peas, ear fill in sweet corn, and length and straightness of snap beans. For improved germination, irrigation facilitates seeding in dry periods, softens crusted soils, promotes quick germination of pelleted seed, prevents wind erosion, and promotes preemergence weed control. Irrigation also increases the efficiency of fertilizer whether preplanted, sidedressed, or topdressed.

31. CARREKER, J. R. Cotton irrigation. Plant Food J. 8(4):6-7,18-19. Oct./Dec.1954. 57.8 P692
Includes a table of research results showing cotton yields with and without irrigation in South Carolina, Georgia, Alabama, Mississippi, Arkansas, and Missouri for 1949-53. Yields ranged from 742 lb. to 2,665 lb. per acre without irrigation and from 1,201 lb. to 3,458 lb. per acre with irrigation. Inches of rainfall and amount and number of applications of water are also given.

32. CARREKER, J. R. How to operate sprinklers most efficiently. Amer. Fruit Grower 73(6):11,42. June 1953. 80 G85
For maximum efficiency a sprinkler system should be designed to apply water at the infiltration rate of the soil, should be large enough to cover the total acreage as needed, spaced for even distribution, have ample water supply, have proper size of pump and motor, have large enough main and lateral lines, be operated carefully, have a schedule of operation, and have other production practices adjusted for optimum levels with irrigation.

33. CARREKER, J. R., and LILLARD, J. H. Irrigation practices for pastures and forage crops. U. S. D. A. Ybk. Agr. 1955:430-434. 1 Ag84Y
Pasture yields at Pennsylvania State University were increased from 2,950 to 5,770 lb. of dry matter per acre with irrigation. The addition of 260 lb. of nitrogen in addition to irrigation gave a yield of 8,050 lb., and 220 lb. of nitrogen gave a yield of 6,020 lb. per acre. Irrigation generally shows increased growth of the legume in mixed stands. Irrigation increased the cow days of grazing by 53 percent in Tennessee and 33 percent in Georgia. Virginia Polytechnic Institute reports increases of 43, 49, and 60 percent in numbers of cow days in 3 out of 5 years. Little or no irrigation was needed the other 2 years. Mississippi Agricultural Experiment Station reports an increase from 10.1 tons to 21.4 tons of green weight of Sudangrass with irrigation. Millet increased from 8.9 to 20.6 tons green weight when irrigated.

34. CARREKER, J. R. The Southeast looks at supplemental irrigation. What's New Crops & Soils 6(8): 16-17. June/July 1954. 6 W55
A review of irrigation research at various southern experiment stations, with brief summaries of results. At the Middle Tennessee Experiment Station at Columbia, from 1945 through 1948, irrigated pastures produced a 43-percent increase in milk worth $61.30 per acre per year. At the Dairy Experiment Station, Lewisburg, Tenn., in 1951, a 51-percent increase in milk brought an increase in net profit of $121 per acre. In 1952 the increase was 56 percent or $115, and in 1953 it was 44 percent or $62. At Athens, Ga., corn-yield increases due to irrigation varied from 2.3 bu. per acre in 1948, to 59.5 bu. in 1952. The average corn-yield increase was 24.7 bu. per acre for 1936-53. Tomato yields at Athens increased 193.2 percent in 1952, and decreased 15.2 percent in 1948. The average increase for the 7 years, 1947-53, was 51 percent - from 15,270 lb. to 23,734 lb. per acre. Cotton yields at Athens from 1949 to 1953 averaged 1,902 lb. of seed cotton per acre when irrigated, compared to 1,217 lb. per acre when unirrigated.

35. CHAPMAN, P. W. Turn water into dollars. Prog. Farmer, Ky.-Tenn.-W. Va. Ed. 67(5):62,68-70. May 1952. 6 P945K

Experiment stations from several States report results of irrigation. Georgia: Potato production was boosted from under 100 bu. to 533.09 bu. per acre; turnip greens from 5 tons to 20 tons per acre. South Carolina: Profits from a 17-acre peach orchard went from $10,000 to $30,000 per year at an initial cost of $4,000. Tennessee: At an annual cost of $18, turnip-green production increased by 3.76 tons per acre for a net increase in profit of $94 per acre. Irrigation of a dairy pasture increased permissible number of cows grazed by 36.5 percent, quantity of milk produced by 43 percent, and total net income by 43.2 percent.

36. CHESNIN, L. Off-season irrigation pays! Better Farming Methods 29(5):42,44. May 1957. 58.8 B46

The cost of irrigating each acre decreases as the number of irrigated acres is increased. Off-season irrigation of fields which are not irrigated during the growing season is recommended to bring down total cost of irrigation and to increase the farm income. Alfalfa fields irrigated before seeding, and cornfields soaked to a depth of 5 or 6 ft. before planting, increased yields even without further irrigation.

37. CHRISTIANSEN, J. E. Irrigation in relation to food production. Agr. Engin. 34:400-406,410. Ref. June 1953. 58.8 Ag83

A brief history of the development of irrigation in the world, in the United States, and in the Western States is given. Comparisons are made between 1939 and 1949 on acreages by States, crops, investments, and production. Future trends and demands are given to point out the need for continued expansion.

38. CLARENBACH, F. A. Irrigation and trends in water rights law. Irrig. Engin. & Maintenance 6(13):20, 30-32. Dec.1956. 55.8 Ir722

The heart of the water-rights problem is the need for an equitable and efficient basis for sharing scarce water among the many who need and want it. Riparian rights, common in the East, do not give a definite and secure right to continued use. Western water laws have many distinct variations of appropriative-rights doctrines. Conflicts in uses of water point out the need for clarification and flexibility in water laws. Basic water policies adapted to the needs of water users are necessary before legal doctrine can be formulated.

39. COLWICK, R. F. Impact of supplemental irrigation on cotton mechanization. Cotton Gin & Oil Mill Press 58(21)42. Oct.19,1957. 304.8 C822

Irrigation of cotton brings up many problems that have not been answered. Mechanization of certain processes in cotton raising is drastically affected. Land leveling needs to be done prior to the planting operations; fertilizing is affected and can often be combined with the irrigation; weed control because of increased weed growth and more rank growth of the cotton is a problem; insect control is generally made more difficult; harvesting may be more difficult because of longer fruiting period and the more rank growth requiring the more expensive high drum mechanical picker; and residue management is more difficult.

40. CROSS, C. L. Package power plan sells irrigation. Rur. Electrif. Mag. 14(9):56,66. June 1956. 335.8 N21

The use of electric motors for pumping from wells has been increased by using rental service, utilizing offpeak power at a cheaper rate, and promotion of other advantages of electricity. Motors were rented for an annual rate of $200 for 3-phase equipment and $100 for single-phase equipment. The use of automatic shutoff equipment so that the motor was in operation only during the offpeak time of day enabled some farmers to save as much as $1.50 per horsepower per month.

41. CROWE, G. B. Essential managerial and economic considerations. (Sum.) Cotton Gin & Oil Mill Press 58(26):31-33. Dec.28,1957. 304.8 C822

The use of irrigation will require the modification of nearly all other factors of production. The farmer must decide on the size of the irrigation system, sources of water, method of irrigation, when and how much to irrigate, and many other considerations. All of these will have an effect on yield uncertainties, costs, returns, and demand for such factors as labor and capital.

42. DAVIDSON, J. H. Power requirements for irrigation use. Rur. Electrif. Mag. 11(3):32,58. Dec.1952. 335.8 N21

The amount of electric energy required for pumping water for irrigation depends on the amount of water lifted, the total equivalent height it is lifted, and the efficiency of the pumping system. The number of kilowatt-hours is determined by multiplying the acre-feet by the pounds per square inch and multiplying this result by the constant 4.7 (which allows for an efficiency of 50 percent in conversion of electrical to mechanical energy). A graph is given for computing annual irrigation power requirements.

43. DONAHUE, R. L. Irrigation practices. In his Soils, chap. 17. Englewood Cliffs,N.J.,Prentice-Hall, 1958. 56 D712S

A general discussion of irrigation, primarily in the West. Data is given on water quality, plant consumptive-use rates, water-holding capacities of soils, amounts and frequency of irrigation, and methods of irrigation. A short list of the advantages and disadvantages of sprinklers is given.

44. DON'T wait for ocean water. Farm Mangt. 4 (7):26-27. July 1955. 281.8 F2225

Cost of converting ocean water to fresh water under present methods is about $400 to $500 per acre-foot. Research hopes to get this cost down to $100 to $125 in the future. The goal for the 5-year program is to reduce the cost to $125 for domestic use and $40 for irrigation per acre-foot. Progress is being made but there is no prospect for wide usage in the immediate future.

45. DOWLING, S. E. How to buy an irrigation system. 1-4. Citrus Indus. 38(9):9-10; (10):18-19,27; (11):25-26; (12):20-21. Sept.-Dec.1957. 80 C49

Annual cost of irrigation needs to be calculated for each system. A procedure is given for computing fixed costs of depreciation and interest. A sample design is included for each system. Methods are shown for selecting size of irrigation lines, power units, size of pump, and type of fuel. In the example used for 160 acres of citrus the annual cost was $44.61 per acre. It is essential that the irrigation system be designed to meet the needs of the particular situation.

46. DUNLOP, S. G., TWEDT, R. M., and WANG, W. L. L. Salmonella in irrigation water. Sewage & Indus. Wastes 23:1118-1122. Sept.1951. 293.8 Se8

Salmonella organisms were recovered from a significant proportion of samples of irrigation water contaminated with a primary-treated sewage-plant effluent. The organisms were not, however, recovered from vegetables irrigated with this water. Irrigation had been by the furrow method, and hence the water had not touched the leaves of the vegetables. Root crops might be expected to be contaminated to a greater extent.

47. DUNSTAN, G. H., and LUNSFORD, J. V. Cannery waste disposal by irrigation. Sewage & Indus. Wastes 27:827-834. July 1955. 293.8 Se8

Spray irrigation as described is a waste-disposal method, and is not likely to return any profit. It attempts to discharge a large quantity of waste on as small an area as possible without regard to the crop requirements, except to avoid killing the vegetation. However, some return from hay, or use of land for pasture, is usually possible.

48. EHLERS, W. F. Costs of irrigation. U. S. Agr. Res. Serv. ARS-43-52:36-39. May 1957. A281.9 R313A

Slightly over one million acres per year were added to the irrigated land of the United States from 1945 to 1954. The average investment in irrigation in 28 Eastern States in 1954 was $5,542 per farm or $145 per acre irrigated. Investment costs per acre irrigated were $166 for portable sprinklers, $577 for fixed overhead pipe, $80 for portable gated pipe, and $38 for flooding. As the size of the acreage irrigated increases, the investment per acre decreases. When the acreage was under 10 the investment was $500 per acre and when the size was over 1,000 acres the investment was $54 per acre. Operating costs vary a great deal with such factors as amount of use, size of irrigation system, source of water, method of irrigation, kinds of crops irrigated, and management affecting operating costs. These costs may vary from a few cents to several dollars per acre-inch.

49. ELLIS, H. M. Seven helpful pointers on how to irrigate. Prog. Farmer, Miss.-Ark.-La. Ed. 68(2): 54-55. Feb.1953. 6 So81
The seven pointers are: 1, Irrigate only high-cash-value crops such as berries, vegetables, tobacco, and dairy pasture; 2, make a thorough study of your individual needs—size of nozzles, pressure required, etc.—before buying; 3, be sure your soil is adapted to sprinkler irrigation; 4, buy a rain gauge to help you determine the right time to irrigate; 5, use plenty of fertilizer; 6, be sure sufficient extra labor is available for at least 11 man-hours per week for each 20 acres irrigated; 7, be prepared to devote time and trouble to proper care of the system when it is not in use.

50. ENNIS, L. What irrigation can do for yield—as demonstrated in the South. Com. Fert. 87(3):24-25. Sept.1953. 57.8 C73
Inadequate water supplies prevent the majority of farmers in the South from irrigating. Low farm prices and the high cost of labor are another deterrent. The major deterrent, however, is the lack of long-term credit. Loans should be payable over a long enough period to allow the irrigation system to show a substantial profit. Cites examples of increased profits due to irrigation in the South: An increase in corn yield of 90 bu. per acre; 41 to 55 percent more cow days of grazing and 43 to 50 percent more milk from irrigated pasture; a seed-cotton increase of 1,089 lb. per acre.

51. FM SPRINKLER report: Secondhand rain. Farm Mangt. 2(7):43-58. June 1953. 281.8 F2225
Sprinkler systems are used on over 650,000 acres on over 20,000 farms in the United States. Nearly 2/3 of the sprinklers are in the 7 Pacific slope States. Under extremely hot, dry, and windy conditions the evaporation from sprinklers may run as high as 33 percent. Spraying or dusting schedules need to be coordinated with sprinkler irrigation operations. Advantages of sprinklers are: Irrigation of land which could not otherwise be irrigated; saving in water under most conditions; and control of erosion. Includes discussion of methods of sprinkler operation, and selection of a system, and general guides to good design and operation of sprinklers.

52. FARMING with push-button rain; more uses cut sprinkler costs. Farm Mangt. 5(12):42-44. Dec.1956. 281.8 F2225
As sprinkler systems are used more and more the cost per acre-inch or acre-foot goes down rapidly. Other uses such as fertilizer application, frost protection, fire protection, cooling of buildings, and applying insecticides or weedkillers should be considered.

53. FINANCING sprinkler systems. Farm Mangt. 3(12):18-20. Dec.1954. 281.8 F2225
Credit arrangements for sprinkler irrigation systems are available from local banks, implement dealers, Production Credit Association, National Farm Loan Associations, the Farmers Home Administration, insurance companies, and personal friends or investors. A few companies offer sprinkler equipment on a rental-purchase arrangement.

54. FOGEL, M. Selection of pumping equipment for irrigation. S. Dak. State Col. Agr. Ext. Ext. C. 503, rev.,15 p., Aug.1957. 275.29 So85
It is very important to design the pump installation for the conditions it will be required to meet. A general guide is that about 8 gal. per minute are needed for each acre to be irrigated. The estimated cost of operating a pumping installation is about $.045 per foot of head per acre-foot for gasoline. This operating cost is about $.035 for propane and electric, and $.03 for diesel-powered units. Tables are also given for estimated depreciation and other fixed costs of pumping installations.

55. FRANCIS, C. J., and TURELLE, J. W. Irrigating corn. U. S. D. A. Farmers' B. 2059,14 p. Oct.1953. 1 Ag84F
Studies have shown that when corn is making its fastest growth it will use as much as 1/2 in. of water every day for several days. In humid areas only 1 ft. of supplemental water will usually be required during the growing season. Discusses furrow and sprinkler irrigation and lists advantages and disadvantages of the latter. Among the disadvantages are high initial cost and greater water and power requirements. Among the advantages are lack of soil erosion, even distribution of water, more economical use of water, and the absence of the necessity for land leveling and ditch construction.

56. FREE, G. R., and others. Supplemental irrigation—what does the future hold? What's New Crops & Soils 7(8):12-14,28. June/July 1955. 6 W55
L. J. Strickland, H. Kohnke, H. Rubey, W. A. King, J. R. Carreker, and K. J. Kucinski, joint authors.
In Missouri irrigation may be installed at an original cost of $60 to $125 per acre, with an annual upkeep of $20 to $25 per acre irrigated. With either surface systems or sprinklers the yield will be doubled. In South Carolina the yield of corn increased from 20 to 100 bu. per acre after irrigation. In experiments at Clemson College, irrigated pastures of pearl millet showed a net gain of $41.76 per acre in feed value. Irrigation of Bermudagrass, Ladino-clover, and fescue pastures was less successful.

57. FRIEDMAN, A. R. Sprinklers. Farm Equip. Retailing 15(3):28. Mar.1953. 58.8 F2292
Sprinklers themselves are the most important feature of sprinkler-irrigation systems but their cost represents only about 5 percent of the total investment. Investment cost of sprinkler systems generally varies from about $75 to $100 an acre. A typical system for irrigating 40 acres would cost about $3,600. Per acre costs each year would be about $2.25 for interest, $.45 for taxes and insurance, $6.00 for depreciation, $4.00 for power costs, $8.00 for labor, and $3.00 for maintenance, for a total of $23.70 per acre per year.

58. FUHRIMAN, D. K., and SMITH, R. M. Irrigation practices in Puerto Rico. Agr. Engin. 32:46-50. Jan. 1958. 58.8 Ag83
Irrigation of sugarcane in Puerto Rico is often quite inefficient since the system commonly used permits 50 to 70 percent of the water to be wasted through deep percolation. Suitable reservoir sites are scarce and expensive, costing as much as $227 per acre-foot of storage capacity.

59. GAMMON, J. Aluminum aids irrigation. Fruit & Veg. Rev. 15(2):16. May 1953. 80 C1224
Light-weight portable sprinklers made of aluminum save time and labor in moving, placing, and handling the pipes. They may be used not only for irrigation but for economical weed, pest, and frost control.

60. GARTON, J. E. Pumping plant efficiency; when it's low, just what does it cost? Irrig. Engin. & Maintenance 7(12):15,34-35. Nov.1957. 55.8 Ir722
A farmer needing to pump 360 gal. per minute against a total head of 150 ft. and needing 80 acre-feet per year can afford to invest $1,147.46 more in a pump with 80 percent efficiency than in a pump with 60 percent efficiency. This figure was obtained by capitalizing the cost of the extra fuel needed for the larger motor required by the less efficient pump.

61. GARTON, J. E. Siphon tubes: How many are needed? Irrig. Engin. & Maintenance 7(11):13. Oct.1957. 55.8 Ir722
Siphon tubes are commonly used for taking irrigation water from the head ditch into rows or furrows. The number needed varies with the amount of head, inside diameter of the tubes, and the rate of flow into the head ditch. A scale is set up for quick calculations. For example, if the operating head averaged 4.75 in. and 1-in. tubes were used the rate per tube would be 7.75 gal. per minute. If the rate of flow into the head ditch was 620 gal. per minute then 80 siphon tubes would be needed.

62. GATTIS, J. L. Tailoring irrigation systems to specific practical needs. Cotton Gin & Oil Mill Press 58(21):42-43. Oct.19,1957. 304.8 C822
There are many considerations in designing irrigation systems for best results. Availability of water, soil and topographic surveys, selection of irrigation method, labor and management resources available, and effects on costs and returns of each crop. Each system is different and it is essential that thorough investigation be made before the system is installed.

63. GIBBS, O. E. Irrigation, a production tool not an insurance measure. Better Farming Methods 29(5): 36,38,40. May 1957. 58.8 B46
Lists and discusses briefly the elements to be considered by farmers before investing in irrigation equipment: Design, operating capital, soil, possibilities for double cropping, labor requirements, plant analysis, and plant populations.

64. GRAUGNARD, E. H. Study of results of sugar cane irrigation costs against benefits received, F. A. Graugnard, 1955. Amer. Soc. Sugar Cane Technol. Proc. 5:52. Jan.1957. 65.9 L932
Three irrigations of sugarcane cost $10.17 per acre in operating costs and $5.31 per acre for depreciation of equipment, for a total of $15.48 per acre. Returns in 1955 were $249.19 with irrigation and $205.56 without irrigation. Net profit per acre by irrigating was $28.15 above the cost of irrigation.

65. GRAY, A. S. Sprinkler expectations. Irrig. Engin. & Maintenance 5(4):18-19,41. Apr.1955. 55.8 Ir722
Proper planning and operation will do much to bring about the desired results with sprinkler irrigation. Essential features in planning are: 1, Consideration of the soil, crop and the climate; 2, pressure for the nozzle size and droplet size desired; 3, spacing of the sprinklers for the best coverage; and 4, design to keep friction loss below 10-lb. pressure. Frost protection by sprinklers has been successful and is best when small nozzles and high pressures are used so that a fog is formed.

66. GRAY, A. S. Sprinkler irrigation information. South. Calif. Rancher 20(8):7. Aug.1955. 6 So831
Water saving will average 50 percent and labor saving will average 25 percent over other forms of irrigation, while the crop increase will vary from 50 percent to several hundred percent, depending on the rainfall distribution. In drought periods of from 4 to 6 weeks one sprinkling can increase yields 50 percent to 100 percent, and in prolonged droughts, sprinklers can mean the difference between crop failure and a bumper crop.

67. GRAY, A. S. Sprinkler system suggestions. Fruit & Veg. Rev. 17(2):10-11. May 1955. 80 C1224
The frequency and amount of irrigation depends largely upon the soil type. The cost of irrigation depends not only on soil texture, but also on the land slope, relative land elevations, location of water source, water level in wells, hours of operation per day, and type of sprinkler system. A completely permanent system will have a high initial cost and a low operating cost, whereas a completely portable system will have a low initial cost and a high operating cost. A system with a permanent pumping unit and permanent main lines, with portable sprinkler laterals, is the most economical.

68. GRAY, A. S. What to look for in portable sprinklers. Fruit & Veg. Rev. 15(2):12-13,21. May 1953. 80 C1224
Tells under what soil and other conditions portable sprinklers are to be desired, and explains how to estimate the initial cost and operating costs of the system.

69. GREENSHIELDS, E. L. 8 million more acres irrigated during the past 10 years. Agr. Situation [Washington] 37(4):5-6. Apr.1953. 1 Ec7Ag
1950 census-of-agriculture statistics show the leading Eastern States in supplemental irrigation in 1949 were: New Jersey, New York, Massachusetts, Michigan, Wisconsin, and Connecticut. The 3 subhumid States of Arkansas with 422,000 irrigated acres, Louisiana with 577,000 and Florida with 365,000 account for over 4/5 of the irrigation outside the 17 Western States.

70. GREENSHIELDS, E. L. Irrigation progress. Farm Impl. News 78(2):58-59. Jan.25,1957. 58.8 F22
Brief resumé of crops grown, acreages irrigated, costs and returns from a special irrigation survey made by the U. S. Department of Agriculture and the Bureau of the Census in 1955 for 28 of the 31 States east of the Great Plains. Arkansas, Louisiana, and Florida are excluded.
Costs for sprinkler and other equipment, constructing ponds, drilling wells, and preparing land, averaged around $5,500 per farm. By States, the average cost ranged from about $2,800 to $10,000 per farm. The average of these costs for acres irrigated in 1954 was $150 per acre, ranging from $65 to nearly $500. Typical returns on tobacco irrigated at the North Carolina Agricultural Experiment Station were $.129 per pound more than on nonirrigated tobacco in 1951, $.033 more in 1952, and $.052 more in 1953.

71. GREENSHIELDS, E. L. Irrigation's part in farm production. Agr. Situation [Washington] 37(5):9-10, 16. May 1953. 1 Ec7Ag
Examples of average yield increases on irrigated lands in the 17 Western States and Arkansas, Louisiana and Florida as reported to the 1950 census of irrigation are: Over 3 tons of alfalfa per acre as compared with 1 3/4 tons without irrigation; 300 bu. of potatoes, with 160 bu.; 1.2 bales of cotton per acre, with 1/2 bale; spring wheat, 33 bu. with 10 bu. Economic advantages of irrigation to the farmer include increased production without increased acreage, and better distribution of use of labor and machinery.

72. GREENSHIELDS, E. L. Trends and economics of irrigation in humid areas. Washington, U. S. Agr. Res. Serv., Prod. Econ. Res. Br., 1956. 10 p. A281.9 G85
Of the 29.6 million acres irrigated in 1954 about 27 million are in the 17 Western States and 1.6 million acres in the 31 humid-area States. Approximately 25 percent of the irrigation in the humid area is on field crops such as cotton, corn, tobacco, and small grains, 21 percent is on vegetables, 17 percent is on hay and pasture, 14 percent is on rice, 13 percent is on Irish potatoes, 5 percent on berries, fruits, and nuts, and 3 percent on flowers and other horticultural crops. About 80 percent of the irrigation in the humid area is done by sprinklers. About half the farmers irrigate from streams, and about a fifth each from springs and wells.

73. HALL, J. More water, grass, milk. Amer. Agr. 148:410-411. July 21,1951. 6 Am3
Condensed reports of controlled experiments with irrigating pastures in Maine and Illinois. Maine information is taken from a preliminary report of a 1-year test conducted by the Maine Agricultural Experiment Station in 1950. Irrigation, applied to half a test plot of mixed grasses and clover, produced an increase in milk production of 1,378 lb. per acre over the nonirrigated half.
In Illinois, 2 plots seeded with a combination of pasture crops were fertilized and further divided into subplots to receive different soil treatments. In 1948, the best plots produced 3,666 lb. more dry matter, and in 1949, 4,053 lb. more dry matter with irrigation than the corresponding unirrigated plots.

74. HAMILTON, F. B., and SCHRUNK, J. F. Sprinkler vs. gravity irrigation—a basis for choice of the best systems. Agr. Engin. 34:246-250. Ref. Apr.1953. 58.8 Ag83
Comparison of sprinkler- and gravity-irrigation systems is nearly always best on an individual farm basis. In making this comparison it is necessary to consider initial cost, depreciation, operating costs, efficiency of water application, and personal preferences. More detail is given under each of these items but few actual comparisons are made.

75. HAMMAN, A. J. Basic principles of irrigation. Better Farming Methods 26(5):20,22-23. May 1954. 58.8 B46
The basic principles are water supply and methods of irrigation. The problem of water supply includes availability, quality and rights of use. Methods of irrigation include flooding and sprinklers. Each of these methods is further subdivided into several types. Flooding includes wild flooding, contour flooding, border-checks, furrows, corrugations, and small trenches, Sprinklers are the most modern method and are well adapted to hilly land, shallow soils, and sandy soils.

76. HARD, E. Irrigated cotton—mill headache? Textile Indus. 118(6):130-133. June 1954. 304.8 C823
The wider variation in staple length of irrigated cotton over unirrigated cotton disturbed the spinners, because it involved a problem of proper roll setting and drafting. How this problem was solved is outlined here. It was found that though the staple length of irrigated cotton was less uniform the average length was greater than that of unirrigated cotton, and the fiber clung tenaciously to other fibers when twisted into yarn. Twist could therefore be reduced, making for savings in manufacturing.

77. HARGREAVES, G. H. Irrigation requirements based on climatic data. Amer. Soc. Civ. Engin. Proc. Paper 1105,10 p. Nov.1956. 290.9 Am3Ps
An outline of the procedure for computation of month to month consumptive-use requirements for a given set of climatic, cultural, and crop conditions. The Blaney-Criddle formula is used and discussed in detail. Tables of coefficients are given for the different latitudes of the United States.

78. HARPER, F. B. Ponds and lakes for fruit growers; a vital source of water for irrigation and spraying. Amer. Fruit Grower 70(6):11,27. June 1950. 80 G85
A general discussion of the economic value to fruit-growers of ponds as sources of irrigation water. Costs are given in general terms. Cites the experience of a South Carolina peach grower whose irrigated peaches sold for $2 more per bu. during a drought year.

79. HAWKINS, G. P. Financing sprinkler irrigation systems. Irrig. Engin. & Maintenance 4(3):12-13,29. Mar.1954. 55.8 Ir722
Loans for purchase of sprinkler-irrigation systems are available to qualified borrowers from the Federal land banks through the local National Farm Loan Associations, Farmers Home Administration, Production Credit Association, rural electrification associations, dealers, and local banks.

80. HAWKINS, G. P. Push-button sprinkler irrigation. Irrig. Engin. & Maintenance 4(2):14-16. Feb.1954. 55.8 Ir722
A completely automatic sprinkler-irrigation system invented by Frank L. Zybach, a farmer near Strasburg, Colo. The system, which moves by hydraulic pressure, was first used in 1952, and was used for the full season in 1953. Costs are about double those of a conventional sprinkler system, but saving in labor costs will pay for them in most situations in a very short time.

81. HAWKINS, G. P. Sprinkling with the big guns. Irrig. Engin. & Maintenance 4(6):12-14,29-30, June 1954. 55.8 Ir722
It is an old argument as to which is better for irrigation, the small sprinklers or the large sprinklers. Labor requirements of both types are generally about the same, but fuel costs and investment will be higher for the large sprinklers. Fewer moves are necessary with the large sprinklers but the distances moved are further and the weight is heavier. Most farm operators find that the smaller sprinklers are more satisfactory.

82. HAWKINS, G. P. This matter of sprinkler tubing. Irrig. Engin. & Maintenance 5(12):14-15. Dec. 1955. 55.8 Ir722
Comparative costs and general estimate of length of life of aluminum, steel, plastic, transite, and cast-iron pipe.

83. HAWKINS, G. P. West vs. East in sprinkler irrigation. Irrig. Engin. & Maintenance 4(5):12-13,21-25. May 1954. 55.8 Ir722
Eastern and western farmers generally use somewhat different design of sprinkler-irrigation systems. In general the easterner uses a less permanent type of installation, electricity as the source of power, lighter applications, and greater spacing of the sprinklers. Much of this difference is due to climate and rainfall patterns.

84. HAWKINS, G. P. Wheels for sprinkler systems. Irrig. Engin. & Maintenance 2(10):6-13,16-17. Dec.1952. 55.8 Ir722
Several different systems of sprinklers on wheels have been in use in the Western States for several years. In nearly all instances they are used on close-growing crops such as pasture, alfalfa, or grain. Wheels can be used on row-crops if the soil is light so that the system does not get bogged down in mud. Wheels on the sprinkler systems generally save 50 to 80 percent of the labor, costs are higher, moving from one field to another is more difficult, and repairs will generally be higher.

85. HESSLER, L. E. Irrigated cotton; factors for consideration in spinning. Textile Indus. 114(7):81-83. July 1950. 304.8 C823
Cotton which depends entirely upon irrigation for water can be grown under controlled conditions. If the water is added to produce a fiber of optimum physical character, a cotton of uniformity and quality is the result. The cotton fiber which will meet top yarn specifications is likely to be the cotton grown under controlled moisture conditions, Cotton to which too much water has been applied, however, produces fiber of little body and strength.

86. HOARD'S Dairyman round table: Pasture irrigation pays off. Hoard's Dairyman 101:177,184-188. Feb.25,1956. 44.8 H65
Representatives from Massachusetts, Maryland, Virginia, Florida and 3 Western States discussed aspects such as increase in pasture capacity, time required to move pipes, and why irrigation is profitable. Sprinkler systems were used in Virginia, Massachusetts, and Maryland, and a seepage system in Florida. On irrigated pasture in Maryland a herd of 54 Holsteins produced an average of 12,060 lb. milk and 451.2 lb. butterfat per year. In Virginia irrigated pasture produced an average of 12,755 lb. milk and 463 lb. butterfat from 85 cows. In Massachusetts 64 cows averaged 9,559 lb., milk and 380 lb. butterfat on irrigated pasture. And in Florida, 137 Jerseys produced an average of 415 lb. butterfat on irrigated pasture.

87. HOUK, I. E. Irrigation engineering, v. 1. New York,Wiley,1951. 545 p. 290 H81
Chapters are devoted to soils, soil fertility, soil moisture, moisture movement in soils, climatic factors, stream runoff, snow melting, evaporation, irrigation and water requirements, losses and waste of irrigation water, water supplies, quality of water, irrigation of alkali soils, and preparation for and procedures of irrigation.

88. HOW MUCH and when to irrigate? Farm Mangt. 3(12):32-35. Dec.1954. 281.8 F2225
Use of the tensiometer in determining when to irrigate is discussed in detail.

89. HOWLAND, W. E. Selecting irrigation pipe sizes for economy. Agr. Engin. 38(7):530-534. July 1957. 58.8 Ag83
Two methods are presented for determining the most economical combination of lengths and standard sizes for a pipe to irrigate a narrow strip of field of a given length at a given rate of discharge per unit length of pipe and at a given total head loss. Cost of a system to irrigate a given field was $1,375 where 950 ft. of 6-in. pipe was used. The cost was $1,095 where 360 ft. of 6-in.; 320 of 5,; 180 of 4; 60 of 3; 20 of 2 1/2; and 10 of 2-in. pipe were used. Using the design methods suggested would result in considerable saving in cost of sprinkler pipe.

90. HUNT, H. J. Supplemental irrigation with treated sewage. Sewage & Indus. Wastes 26:250-260. Mar.1954. 293.8 Se8
Treated sewage effluent for supplementary irrigation is probably best adapted for use on pasture plants. Rainfall deficiencies based on a minimum seasonal requirement of 23.5 in. vary from 3 in. at New Orleans to 23 in. at Indio, Calif.

91. HUTCHINS, W. A., SELBY, H. E., and VOELKER, S. W. Irrigation-enterprise organizations. U.S.D.A. C. 934,107 p. Oct.1953. 1 Ag84C
A study of the organization of irrigation enterprises in the West. They are grouped into three general classes: Irrigation districts, mutual companies, and commercial enterprises. Advantages and disadvantages of each are discussed, and such characteristics as purpose, organizational procedure, powers, financing, revenue, water service, management, taxation, and public regulation are described. Charges for delivery of water to the farm vary from $.50 to $19.37 per acre per year.

92. IOWA. AGRICULTURAL EXPERIMENT STATION. Iowa sprinkler irrigation guide. Iowa. State Col. Agr. Ext. Spec. Rpt. 11,15 p. June 1955. 100 Io9Sp

A guide is prepared for the use of designers of sprinkler systems. Discusses the basic steps the irrigator must follow to obtain profitable crop yields with irrigation: Provide adequate and dependable water supply, purchase a custom-designed system, and plan for high yields.

93. IRRIGATION. Breeder-Stockman 16(12):9-11, 98-99. May 1955. 49 V81

Pasture irrigation in the Eastern States is discussed pro and con. Farmers are urged to use caution in investing in irrigation equipment solely for pastures. Summer feed from annual crops such as soybeans may be more economical than irrigating a permanent pasture. Rental of an irrigation system at $5 to $50 per acre-inch application may prove cheaper than owning a system. Cites examples of pasture irrigation which have proved profitable: In Pennsylvania application of 6 to 11 in. of supplemental water per year has increased dry matter by as much as 1,545 to 2,425 lb. per acre. At the Alabama Agricultural Experiment Station beef production has been increased more than 200 lb. per acre per year as a result of pasture irrigation. At the Mississippi Station, yield of sorghum silage was increased from 36,078 to 46,199 lb. per acre by irrigation, and corn silage was increased from 14,661 to 31,765 lb. per acre. In tests in New Jersey, Pennsylvania, and New York, 500 to 800 lb. of dry matter per acre has been the average annual increase from irrigation. The annual expense of irrigating an acre of pasture in New York State is estimated at $22 to $30.

94. IRRIGATION; what it is, what it costs. Rur. Electrif. News 16(11/12):9-11. June/July 1951. 173.2 R88Ru

Primarily concerned with types of electric pumps for irrigation, but explains basic terms in irrigation of all kinds, and mentions a few cases in which irrigation has increased farmers' incomes. Explains how to estimate the motor-size requirements of electric pumps, for various lifts and for various gallons of water per minute, and how to estimate the fixed and operating costs of electric-pump irrigation. No specific figures given.

95. IRRIGATION and rainfall under eastern and western conditions. Natl. Peach Council. Annu. 1955:12, 14-15,17-18. 281.3939 N21

South Carolina, Pennsylvania, Michigan and 2 Western States are represented in a discussion of practices relating mainly to peaches. In 1955 in South Carolina there were 60 sprinkler systems irrigating 6,000 acres of peach orchards, representing a total investment of $1,250,000. Operating costs averaged $2 to $3 per acre-inch. In a Pennsylvania peach orchard, the first year of irrigation increased peach yield from 1.6 bu. to 3.2 bu. per tree, with 85 percent of the irrigated peaches being 2 1/2 in. or more in diameter. The annual cost of irrigation was $22.09 per acre, which included $14.77 for depreciation, $6.75 for labor, and $.57 for fuel. In Michigan, peach-tree irrigation is fairly new, as it was believed that with the annual rainfall of at least 40 in., enough water was stored in the subsoil to see the trees through dry periods. The use of moisture blocks in the subsoil, however, proved this theory erroneous. Now it is known that at least 50 in. of water is required for a good peach crop, and the difference is made up by irrigation. It costs about $3.50 for the first acre-inch, and $1.50 for each acre-inch thereafter. The usual single application of 4 in., therefore, costs about $8 per acre.

96. IRRIGATION pays. 1-4. Farm Impl. News 75(6):46-47,106; (8):32-33,54-56; (10):44-47,78; (12):38-41. Mar.25,Apr.25,May 25,June 25, 1954. 58.8 F22

A review of irrigation in the Eastern States since 1939. In all of the humid States the acreage under irrigation doubled between 1939 and 1949. The 1950 census found 828 of the 2,011 counties of the 31 Eastern States with some irrigated farms. The majority were in New England New York, New Jersey, Delaware, and Florida. The largest percentage increase between 1939 and 1949 was in Massachusetts, where irrigated acres jumped from 2,049 to 18,507 acres. Oklahoma showed the second largest increase—from 4,437 to 34,071 acres; and Michigan was third, with a jump from 2,960 to 13,901 acres. Sprinkler irrigation was used on 3 out of 5 irrigated farms in the Eastern States; deep wells were the most common sources of water; and centrifugal pumps, operated either electrically or by internal combustion engines, were the most used pumping equipment. Costs are not given specifically, but cost comparisons are made among various types of sprinkler equipment.

97. IRRIGATION WORKING CONFERENCE, AUBURN, 1951. Proceedings. Auburn,Ala.,1951. 18 p. 55.9 Ir7

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Partial contents: Irrigation research in Alabama, by R. W. Pearson, p. 4; Irrigation research in Alabama, by J. E. Conniff, p. 5-6; Irrigation research in Florida, by J. M. Myers, p. 6-7; Irrigation research in Georgia, by J. R. Carreker and W. B. Land, p. 7-8; Irrigation research in North Carolina, by T. V. Wilson, p. 10; Irrigation research in Tennessee, by A. L. Kennedy, p. 10-11; Irrigation research in Virginia, by J. N. Jones and J. H. Lillard, p. 12-13; Panel discussion on power for irrigation, p. 13; Irrigation of pastures, row crops, and horticultural crops, by L. M. Ware, p. 14; Summary of irrigation studies with vegetable crops in Alabama, by L. M. Ware, p. 14-15; Pasture irrigation, by A. L. Kennedy, p. 16; Personal experiences in pasture irrigation, by A. F. Randall, p. 16-17; Irrigation of row crops in Tennessee, by A. B. Strand, p. 17-18.

98. ISRAELSEN, O. W. Irrigation principles and practices. Ed. 2. New York,Wiley,1950. 405 p. Ref. 55 Is7

A college textbook on irrigation principles and practices. Emphasis is on sources of water, storage, conveyance, measurement, pumping, methods of irrigation, soil and water relations, soil movement, alkalinity, drainage, water needs of crops, field-crop irrigation, orchard irrigation, humid-area irrigation, and social or administrative aspects of irrigation. The chapter on humid-area irrigation emphasizes rainfall deficiencies, equipment costs, crops irrigated, sources of water, methods of irrigation, water rights, and the future of irrigation in the humid area.

99. JOHNSTONE, W. C. Good customers are eligible for irrigation loans. Banking 48(12):68,70. June 1956. 284.8 Am3

Irrigation will help a good farmer do a better job but it won't make a good farmer out of a bad one. Two bankers who are also farmers have had their irrigation systems paid for in 2 to 3 years with tobacco. Irrigation will pay on pasture if it is good pasture and good animals are used on the pasture. The need is for intermediate credit in financing irrigation systems. General guides on sources of water and design are also given.

100. KABLE, G. W. Next summer's rain. Elect. on the Farm 23(2):7-9,34. Feb.1950. 335.8 EL27

Irrigation can be compared to many other farm practices such as fertilization. It represents a major investment and should be considered very carefully. Humid-area irrigation can be contrasted to western irrigation principally on the amount of use given the system. Since it is used less in the humid area the fixed costs are generally high. Benefits of irrigation are in the form of increased yields, reduced risk, better quality, frost protection, and fertilization methods.

101. KENNEDY, B. Can you afford to buy rainfall on credit? Farm & Ranch—South. Agr. Upper So. Ed. 84(12):12-13. Dec.1954. 6 T31

Discusses P.L. 597 (83d Cong.) for Federal direct or insured loans to eastern farmers for irrigation equipment and installation. Outlines the plan of Georgia banks to extend credit up to 100 percent on a 5-year basis to farmers who are justified in their desire for irrigation. Criteria are: Available water, irrigable soil, high-value crops, sound fertilizer practices, good credit, no other farm debts, and know-how in managing irrigated acreage.

102. KERR, H. A. What land is profitable to irrigate? Hoard's Dairyman 101:676-677. July 10, 1956. 44.8 H65

Soil, water supply, use of fertilizer, and forage to be produced are among factors to consider. Tests have shown that highly fertilized pasture yields an almost equal amount of dry matter whether irrigated or not. So when fertilizer is cheaper than water it does not pay to irrigate. However, on deep, sandy, coarse soils, shallow-rooted forage crops such as Ladino clover and most grasses profit greatly from irrigation. Green-weight yield of such irrigated pastures has increased from 5,550 lb. to 14,000 lb. per acre, an increase of 160 percent. But the dry weight of the yield was only 3,600 lb. for the irrigated pasture, compared to 1,930 lb. for the unirrigated — an increase of only 81 percent. Tests have shown that for beef steers the rate of gain is less on irrigated pastures than on unirrigated pastures. Other tests have shown that for dairy cows irrigated pasture is more palatable than unirrigated.

103. KIDDER, E. H. Factors to consider before purchasing irrigation equipment. Veg. Growers Assoc. Amer. Annu. Rpt. 1956:165-169. 81 V52
Irrigation equipment should be used for as many purposes as possible. This may mean for frost protection, establishing new plantings, and for many secondary crops. Of prime consideration is source of water and also the equipment itself. The system should be designed for the conditions and purposes it is expected to meet for each individual farm. General guides are given for selection of equipment.

104. KRANTZ, B. A., and others. Irrigating cotton to insure higher yields. U. S. D. A. Ybk. Agr. 1955:381-388. Ref. 1 Ag84Y
N. P. Swanson, K. R. Stockinger, and J. R. Carreker, joint authors.
Irrigation of cotton increased yields in Georgia by 58 percent from 1949 to 1953. Alabama reports a decrease in the wet year of 1950 of 275 lb. per acre from the yields of 1,328 lb. without irrigation. In 1952 irrigation increased the yield from 1,449 to 2,538 lb. per acre. Arkansas reports yield increases from 1 to 1.57 bales per acre with irrigation in the 3 years from 1950 to 1952. Mississippi reports yields at the Delta Station in 1952 of 2,021 lb. without irrigation and 2,461 lb. per acre with irrigation. In Missouri in 1953 irrigation increased the yield from 1,414 to 3,458 lb. per acre. South Carolina also in 1953 reported seed-cotton-yield increases of 655 lb. with irrigation. Proper timing, fertilization, and management are essential for best results with irrigation. Fiber and seed properties are less affected by irrigation than is yield, but they are improved.

105. KRIMGOLD, D. B. Determining time and amount of irrigation. Agr. Engin. 33:705-707. Ref. Nov. 1952. 58.8 Ag83
The use of Thornthwaite's formula and a bookkeeping system on water supply in the root zone of the particular crop has proved very practical for the farmer on the author's own farm in Maryland and on Seabrook Farms in New Jersey.

106. KRIMGOLD, D. B. Economic feasibility of supplemental irrigation. Agr. Engin. 35:22-27. Ref. Jan. 1954. 58.8 Ag83
The frequency of drought is of prime importance in determining feasibility of irrigation in the humid area. Root zones, water-holding capacities, and plant-use rates are discussed in considerable detail.

107. LARSON, F. H. Humid area soils and moisture factors for irrigation design. Amer. Soc. Civ. Engin. Proc. Sep. 426,30 p. Mar.1954. 290.9 Am3Ps
Basic data needed regarding soil and moisture factors involved in design of sprinkler-irrigation systems for Northeastern United States are given. Emphasis is given to drought frequency, soil-available water-holding capacities, water-use rates, rooting depths, infiltration rates, and climate.

108. LAW, W. P., and LUND, C. M. Extra water—insurance that pays off every year. Prog. Farmer, Miss.-Ark.-La. Ed. 68(2):58,60-61. Feb.1953. 6 So81
"Irrigation fits any farm where there are valuable crops, a good farmer, and a good water supply." Sprinkler irrigation has been found most satisfactory for conditions in the Southeast, with the exception of the rice areas of Louisiana and Arkansas. Gives breakdown of costs of a typical portable aluminum sprinkler system for a 20-acre field 1,000 ft. from the water source. The initial cost is $1,610, or about $80 per acre. This figure includes: Pump, $175; 1,000 ft. of 4-in. main, $950 (which cost would be eliminated or reduced if the field were closer to the water source); other pipe, $400; elbow and risers, $25; and 10 rotating sprinklers, $60. Annual fixed costs for this system would amount to $185, or about $9 per acre. Operating costs for fuel and labor would run about $2 per acre-inch of water applied.

109. LEBLANC, R. J. The irrigation of sugar cane. Amer. Soc. Sugar Cane Technol. Proc. 5:18-21. Jan. 1957. 65.9 L932
Operating cost of sprinkler irrigation of sugarcane was $7.43 per acre per 3-in. application. One planting irrigated only once in October 1952, about 3 weeks after planting yielded 16 tons where irrigated and 13.5 tons per acre without irrigation. Another field planted in September 1952, and irrigated once in June 1953, yielded 26 tons with irrigation and 20.1 tons per acre without irrigation.

110. LIEDER, H. Sprinkler irrigation: Pumping equipment. Farm Equip. Retailing 15(3):22-23. Mar.1953. 58.8 F2292
Centrifugal pumps are generally of two types. Vertical turbine pumps are used for ground water from deep wells and horizontal centrifugal pumps are used for water from streams, ditches, lakes or ponds. Each of these types is further subdivided on the basis of source of power, how attached to the power source, and size.

111. LOUPO, M. W. Gas and diesel engines as sources of power for irrigation. Ala. Polytech. Inst. Agr. Ext. C. 485:24-25. Aug.1955. 275.29 AL1C
The initial cost of an L.P. converted gas engine is $125 to $175 higher than a gasoline engine, but in areas where L.P. gas is a great deal cheaper than gasoline, the L.P. engine will be more economical in the long run. The initial cost of a diesel engine is about twice that of a gasoline engine, but fuel consumption and fuel cost are both less than that for gasoline engines. Considering a 50-hp. installation, diesel fuel at $.15 per gal., and gasoline at $.25 per gal., 300 hours of operation per year will pay for the additional cost of the diesel engine in a period of 10 years. A diesel unit would therefore be justified where operation for 400 to 500 hours per year is standard practice.

112. LYLE, J. A. Disease problems likely to be encountered on irrigated crops and methods of control. Ala. Polytech. Inst. Agr. Ext. C. 485:30-31. Aug.1955. 275.29 AL1C
Sprinkler and overhead irrigation are more apt to cause the spread of disease among crops than is surface irrigation, because the splashing of the water from plant to plant carries disease from one plant to another, and because the increased humidity around the plants creates a favorable environment for the development of disease organisms. Applying fungicides with the irrigation water has been found not to work. Dusting and spraying should be integrated with the irrigation schedule so that there will be the maximum time between the application of the fungicide and the application of water.

113. MCCULLOCH, A. W. Choice of irrigation method must be based on analysis. Impl. Rec. 47(9):33-34,36. Aug.1950. 58.8 Im73
Efficiency in water application involves labor utilization, power costs, land use, efficiency of fertilizer application, crop establishment, and crop returns. States that "the writer found labor costs to be consistently lower for sprinkling than for surface irrigation on the same sites." Labor costs for surface irrigation of a sandy loam soil averaged $30 per acre per season, while labor for sprinkler irrigation of the same field cost only $7.50 per acre per season. The cost of pumping an acre-inch of water through a sprinkler system runs from $.20 to $.60.

114. MCCULLOCH, A. W. The economics of sprinkler irrigation systems. Irrig. Engin. & Maintenance 7(8): 18-19,34-36. Aug.1957. 55.8 Ir722
Many reasons are given by farmers for installation of sprinkler systems. The final question in all cases is whether the net returns are increased over another method of irrigation. Often the costs of sprinkler irrigation are higher but other conditions such as soils or topography make sprinklers the best method for the situa-

tion. A comparison of 9 different sprinkler designs on corn showed little variation in costs ($27 to $33 per acre) except with the full-coverage system which had an annual cost of about $61.50 per acre.

115. MCCULLOCH, A. W., and SCHRUNK, J. F., comps. and eds. Sprinkler irrigation. Washington, Sprinkler Irrig. Assoc., 1955. 466 p. 55 Sp82
Partial contents: Ch. 1, Sprinkler irrigation and high production agriculture; Ch. 6, Fixed and operating costs for sprinkler irrigation; Ch. 7, Sprinkler irrigation results and practices for various crops; Ch. 14, Special uses of sprinkler irrigation equipment.

116. MCINTYRE, E. R. Sprinkling the doubt out of drought. Quonset Farmstead News 3:6-7. Apr./May 1955. 296.8 Q5
A general discussion of the value of irrigation, and guides for its use in the humid areas. Examples are given of gains of $120 per acre in milk production in Tennessee, doubling of beef production in Georgia, increase of $93 gross per acre with corn in Indiana, reports of a 4-year average of 45 bu. of corn per acre without irrigation and 96 bu. with irrigation in Wisconsin, tobacco net profit increased by $162 with irrigation on 29 farms in North Carolina, and tomato yields increased from 6,542 lb. to 18,915 lb. per acre with irrigation. Investment costs will vary from $40 to $200 per acre depending a great deal on the size of the acreage irrigated.

117. MCVICKAR, M. H. Irrigation is income insurance. South. Planter 115(3):8,60. Mar.1954. 6 So89
Supplemental irrigation is rapidly expanding in the South in spite of its high initial costs. Irrigation can be used not only for applying the necessary water, but fertilizer can easily be applied through the system. The bigger yields make it essential to fertilize more heavily.

118. MAGNESS, J. R. Irrigation of orchards in Eastern United States. Va. Fruit 42(2):66-68,70-73,76-77,95-96. Feb.1954. 81 V81B
"There is no question as to the benefit from irrigation on relatively shallow soils and in seasons of poor rainfall distribution. There is no substitute for water in maintaining the growth of fruit." Average yields of apples and peaches can be increased 25 percent by irrigation, and the value of the crop will be increased even more than the yield. Sprinkler irrigation is recommended for eastern orchards. Minimum cost for initial equipment, exclusive of pump, is about $75 per acre. Overall equipment investment would be at least $150 per acre. Assuming a 10 percent depreciation cost, and $10 to $15 power and labor cost, the total cost would be $25 to $30 per year. The increased yield and quality of the fruit from trees on shallow soil will over a period of years more than pay for such costs.

119. MAGNESS, J. R. Your fruit tree and water. Amer. Fruit Grower 75(6):11,32-33. June 1955. 80 G85
Under extreme conditions an apple tree will use up to 125 gal. of water per day and a peach tree about 65 gal. per day. The critical period for peaches is about 35 days before harvest. Irrigation should be done when shallow-rooted plants growing under the trees are wilting. More fertilizer should be used with irrigation.

120. MAKING irrigation worthwhile. Rur. Electrif. News 15(7/8):18-19. Feb.-Mar.1950. 173.2 R88Ru
Electric pumps for irrigation are economical if used in the right places under the conditions for which they were designed. Pumps are designed for a maximum efficiency that will range between 65 and 80 percent. Efficiency will go down when a pump designed to work at 200-lb. overall pressure has to work at 250 lb., or when the pump is called upon to deliver a greater volume of water than that for which it is designed. On a large farm, losses from such inefficient use of pumps could amount to as much as $1,200 per year.

121. MANAGEMENT details important in your sprinkler operation. Farm Mangt. 5(10):20,22. Oct.1956. 281.8 F2225
A reliable dealer in sprinkler-irrigation equipment and pumps will not only provide written instructions on setting up and operating the equipment but will spend considerable time in explaining the characteristics and functions of all the equipment, and the parts will be listed that are subject to the most wear and need to be watched. Proper use and careful adherence to the instructions given are necessary for the most satisfactory use.

122. MARQUIS, R. H. Legal problems connected with the use of water for irrigation. Ala. Polytech. Inst. Agr. Ext. C. 485:59-61. Aug.1955. 275.29 AL1C
The process of changing and clarifying water laws is under way in nearly all of the Southeast. The advantages and disadvantages of the riparian and prior-appropriations systems are discussed.

123. MILLAR, C. E., TURK, L. M., and FOTH, H. D. Irrigation. In their Fundamentals of soil science, Ed. 3, chap. 19. New York, Wiley, 1958. 56 M613
A general discussion of irrigation giving the acreages irrigated by States in 1954 with comparative trends, a short discussion of water rights, and considerable detail on irrigation methods. Nothing is given on the use of sprinklers. Methods of measuring the amount of water are given, and a discussion on water quality is included.

124. MINNICH, J. A. How to select and install underground sprinklers. Org. Gard. & Farming 2(8):22-25. Aug.1955. 57.8 Or32
For home gardeners. Costs not given, but various commercial makes are described, and their respective merits discussed. Also gives instructions for installation.

125. MONROE, P. H. The high and the low. Irrig. Engin. & Maintenance 5(11):15,22-23. Nov.1955. 55.8 Ir722
Comparison of heads of deep-well turbine pumps from the standpoint of performance, customer advantage and manufacturing costs. No figures given.

126. MOORE, W. B. Water makes the difference. Cotton Gin & Oil Mill Press 56(4):9-10,54-55. Feb.12, 1955. 304.8 C822
Summarizes results of cotton-irrigation experiments in 14 cotton-growing States, including those of the Southeast. Gives cotton acreages under irrigation in these States in 1955.

127. MORGAN, R. M. Growth of the giants. Irrig. Engin. & Maintenance 6(8):24-25. Aug.1956. 55.8 Ir722
During the past two years the use of giant sprinklers has expanded very rapidly. This is particularly true of the humid area because of the use of irrigation only as a supplementary practice when rains are inadequate. The high pressure at which they operate makes the drops fall as a gentle rain. The giant sprinklers have proved especially valuable for irrigation of new seedings and for frost protection.

128. MOSELEY, J. M. Irrigation and Bright Leaf quality. Irrig. Engin. & Maintenance 6(6):16-17,48-49. June 1956. 55.8 Ir722
The quality of tobacco is definitely affected by irrigation. On the favorable side, the irrigated tobacco is usually lower in nicotine content, lower in ash, and higher in total yield. Unfavorable effects are similar to those encountered in a wet year, such as loss of grain and flavor.

129. MUELLER, R. C. Sprinkler irrigation, a good water-mark for new profit dollars. Farm Equip. Retailing 15(3):20-22. Mar.1953. 58.8 F2292
The dealer's role in irrigation by sprinklers is to design and stock equipment to meet his customers' needs. This will involve promotion, proper design, active followup, adequate stock, setting up the equipment, and proper operation of the equipment. In addition the financing of the sprinkler system is of concern to the dealer. All of these can be grouped under the heading of good business.

130. MUELLER, R. C. Use sprinklers for more profit. Better Farming Methods 29(6):18,20. June 1957. 58.8 B46
Two important phases of sprinkler irrigation which lead toward more profit for the user, are proper planning of the system, and proper use. Planning should take into consideration the layout of the field, topography, source of water, type and cost of power available, infiltration rates and soil types involved, cropping program, rooting characteristics and moisture requirements of the crops, available labor, and marketing facilities for the crops. Proper

use of the system involves a knowledge of the growing habits of each crop irrigated, so that water may be applied at the right time and in the right amount to avoid waste. Corn, for example, requires maximum moisture at silking time. Pastures irrigated at the right time after seeding may get along the rest of the season with no further supplemental irrigation.

131. NEWMAN, W. Sprinkler irrigation: Fittings. Farm Equip. Retailing 15(3):26,28. Mar.1953. 58.8 F2292
There is a large variety of sprinkler-irrigation fittings available in the form of quick couplers, sprinkler mountings, valves, and similar accessories.

132. NUTT, G. B. Irrigation of cotton in the Rain Belt; progress. Cotton Gin & Oil Mill Press 56(20):44-45. Sept.24,1955. 304.8 C822
Relates progress in research in South Carolina, Georgia, Arkansas, Mississippi, Alabama, and Texas.
Tests with corn at Clemson, S. C., 1946-54, showed that irrigation was profitable 8 of the 9 years with net returns of $73.26 per acre for that period. A cotton-irrigation experiment in 1953 resulted in increases in yields varying from 300 lb. of seed cotton per acre to 655 lb., and in 1954, yield increases from 670 lb. to 1,379 lb., depending upon amounts of water applied. Average yields of cotton in 6 Southern States were 1,572 lb. of seed cotton without irrigation, 2,173 lb. with irrigation, an average increase of 601 lb. — a half bale — per acre, according to a survey in 1954. In Mississippi, in 1952 total dollar value resulting from irrigation ranged from a minimum of $62 to $134 depending upon variety. Decreases from irrigating cotton were reported by the Alabama station in 1950 and by the Mississippi station in 1952. Examples of varying costs of irrigating include: In 1953, costs ranging from $32.15 per acre at State College to $12 per acre at Stoneville reported by the Mississippi station; In Alabama, costs including operating costs, labor, and depreciation on equipment, ranged from $1.50 to $2.75 per acre-inch of water applied.

133. OLEJAR, P. D. Making more of irrigation. Natl. Grange Mon. 50(12):30-32. Dec.1953. 6 N215
A few examples of yield increases and returns in the East are included in this article, which discusses future increased demands for food production, need for information on water requirements of certain crops, and the effects of fertilization combined with irrigation.

134. PARKS, R. Q. Irrigation agriculture and soil research in the United States. Advn. Agron. 3:323-344. Ref. 1951. 30 Ad9
A general historical treatment of the development of irrigation in the United States with emphasis on the West. Farm value of irrigated crops in 1947 was 2.4 billion dollars. Distribution of irrigated acreages by States is shown. Estimates of potentially irrigable land in the humid region vary from 2 to 50 million acres. This may be very conservative, for a more detailed Georgia study indicates a possible 8 to 12 million acres in that State alone.

135. PARKS, R. Q. Supplemental irrigation research. Com. Fert. 87(1):40-42. July 1953. 57.8 C73
Areas in which further research are needed are: 1, Water resources — legal and physical aspects; 2, when to irrigate; 3, how much water to apply; and 4, how to work out the optimum combination of soil, fertilizer, crop and water management, etc., for the achievement of maximum production.

136. PEIKERT, F. W. Does pasture irrigation pay? Hoard's Dairyman 97:466-467. May 25,1952. 44.8 H65
Summarizes experiments with dairy-pasture irrigation in various Eastern States. In Illinois in 1948, a dry year, yields were increased 100 percent. In Georgia grazing days were increased 32.8 percent; heifer-weight-gain increased 26 percent. In North Carolina grazing days increased 98 percent; milk production 120 percent. In Virginia grazing days increased 45 percent; herbage production 62 percent. In Maine irrigated pasture yielded 10,620 lb. per acre of green material compared to 1,869 lb. for unirrigated pasture; cow-grazing days increased 161 percent; milk production increased by $76 per acre. Also discusses sprinkler irrigation and costs.

137. PEIKERT, F. W. Irrigation is more than crop insurance. New Eng. Homestead 127(5):20-23. Mar.13, 1954. 6 N442
Irrigation may mean changing the customary practices of seeding rates, fertilizers, varieties, and many others. Part of the gain from irrigation is in the form of improved quality, use for frost control, fire protection, and application of fertilizer through the irrigation system.

138. PEIKERT, F. W. Problems in planning an irrigation system. Farm Impl. News 71(2):44-45. Jan.25, 1950. 58.8 F22
Irrigation systems need to be designed for each individual farm. There is a place for both small and large systems. The domestic water system can sometimes be used for irrigation of small plots.

139. PEIKERT, F. W. Should you irrigate in '53? New Eng. Homestead 126(5):8-9,18. Mar.14,1953. 6 N442
First costs of irrigation equipment will be usually from $100 to $150 per acre. Where the water is piped long distances this may be as high as $200 per acre. Operating costs will range usually between $22 and $30 per acre per year. Crop-yield increases will need to meet this cost to make irrigation pay.

140. PEIKERT, F. W. Sprinkler irrigation; what you need to know to determine cost of installation and operation. Amer. Fruit Grower. West. Ed. 77(6):9,37. June 1957. 80 G85W
Generally, the annual costs of sprinkler irrigation can be estimated at 50 percent for fixed charges, 30 percent for labor, and 20 percent for power. To keep down investment, the water supply should be located as close to the field as possible, and the system should be used to irrigate as many crops as feasible. False economies, such as buying pipe smaller than indicated, should be avoided.

141. PETERSON, H. B. For better sweet corn balance nitrogen and water. Canner 114(18):14-15. May 3,1952. 286.83 C16
Tests were conducted to determine the best combination of irrigation and nitrogen fertilization for maximum yield of sweet corn. Zero, 50, 100, and 200 lb. of nitrogen were applied respectively to 4 plots. Each plot was subdivided, one third receiving heavy irrigation, one third receiving medium irrigation, and one third receiving no supplemental irrigation. The greatest yield, 22.25 tons per acre, came from the heavily irrigated, maximum nitrogenized (200 lb.) plot. The next highest yield, 16.25 tons per acre, came from the heavily irrigated section of the 100-lb. plot. The third highest yield, 16 tons, came from the medium irrigated section of the maximum-fertilized plot. The unirrigated, unfertilized section yielded 5.87 tons, while the medium-irrigated, unfertilized section yielded only 5.75 tons. The heavily irrigated unfertilized section yielded 7.37 tons.

142. PRESLEY, C. B. Financing irrigation equipment. Banking 47(9):60-61,129. Mar.1955. 284.8 Am3
Loans for purchase of irrigation equipment that is well designed are generally quite safe. Often the farmer obtains enough increased income in one year of drought to pay for the equipment. Initial costs are generally from $65 to $150 per acre irrigated, and operating costs for irrigation will be from $18 to $35 per acre. Yield increases have often been over 100 percent. Payments should be arranged to coincide with the income of the farmer. A dairyman can make regular monthly payments whereas a grower of field or truck crops can best make annual or semiannual payments, depending on what crops he irrigates.

143. PRIMER for pump purchasers. Farm Mangt. 2(7):60-63. June 1953. 281.8 F2225
A general discussion on the use of reservoirs, pump- and power-unit design, types of pumps available, sources of power, sources of water, and pump operation.

144. QUACKENBUSH, T. H., and others. Conservation irrigation in humid areas. U. S. D. A. Agr. Handb. 107,52 p. Jan.1957. 1 Ag84Ah
G. M. Renfro, K. H. Beauchamp, L. F. Lawton, and G. W. Eley, joint authors.
Discusses benefits in general, and gives approximate costs of various types of irrigation, including water supply

and labor and power costs. Where a farm reservoir is available, the initial investment may be from $50 to $200 per acre. When a well is required, the initial cost may run as high as several thousand dollars. Sprinkler irrigation will cost from $80 to $200 per acre. Land leveling for surface irrigation may cost from $25 to $100 per acre. Power costs depend upon the type of power unit used, the cost of fuel, and the efficiency of the plant. Except for electricity, the power cost will vary directly with the horsepower delivered and the number of hours of operation. Labor costs depend on the type of system used, spacing of the lateral lines, height and density of the crop, walking conditions in the field, and the amount of water applied at each irrigation. Operation of a sprinkler system usually requires from 1/2 to 2 man-hours of labor per acre of irrigation.

145. QUACKENBUSH, T. H. Factors influencing irrigation in humid areas. Amer. Soc. Civ. Engin. Trans. 121:179-187. 1956. 290.9 Am3
The nearly 26 million acres irrigated in the United States involve an investment of $1,868,000,000. Seepage, evaporation, and runoff on the farm take about 75 percent of the water diverted, and only 25 percent of it reaches the root zone of the plant. The farmer needs information on water rights, available water supply, water needs of the crops to be irrigated, method of application, crop-yield responses, and drainage if needed. Irrigation increased forage yields at Cornell in 1950-52 by 8.5 lb. per day over the 20.7 lb. per day of dry matter produced with normal fertilization alone. With a high rate of fertilization, the increase attributable to irrigation was 5 lb. per day, and with a medium rate, 4.8 lb.

146. QUACKENBUSH, T. H. Factors influencing the development of irrigation. Washington,Soil Conserv. Serv.,1954. 9 p. 1.96 Ad2Q2
Paper presented to American Society of Civil Engineers, Atlanta, Ga., February 18, 1954.
Census statistics show a 150-percent increase in irrigated acreage in the 31 Eastern States, from 600,000 acres in 1940 to 1,516,000 acres in 1950. Collection of sound data on which to base irrigation-system design, proper design and operation of systems, confront engineers. Development of water laws to reduce the risk to farmers who invest in irrigation systems, and to provide for all water needs are other factors in the scientific development of irrigation.

147. QUACKENBUSH, T. H. Growth of irrigation in humid areas. Amer. Fruit Grower 73(6):34-35. June 1953. 80 G85
Irrigation on some crops and in some areas of the humid area is fast becoming an essential practice and not "supplemental". Over 400,000 acres in the high-rainfall area are being irrigated by sprinklers.

148. QUACKENBUSH, T. H. Humid area irrigation. I-II. Irrig. Engin & Maintenance 4(12):16,29; 5(1):16-17. Dec.1954-Jan.1955. 55.8 Ir722
Irrigation is increasing rapidly in the humid area as shown by acreage increases of 2,817 acres in 1949 to 6,336 acres in 1950 in Virginia, and 12,239 acres in 1953. Several studies of drought frequencies show definite needs for irrigation. Pasture irrigation along with increased fertilizer doubled pasture yields in New York. In Illinois the increase in pasture yield just barely paid for the cost of irrigation, but additional fertilizer was not used. Essential features in successful irrigation are proper design and proper operation. Much more information is needed before all the questions of irrigation are answered.
Also in J. Soil & Water Conserv. 10:25-26,31-32,37. Jan.1955. 56.8 J822

149. QUACKENBUSH, T. H., and THORNE, M. D. Irrigation in the East. U. S. D. A. Ybk. Agr. 1957:368-378. 1 Ag84Y
Irrigation in the 31 States in the humid region has increased 70 percent from 1949 to 1954 according to the 1954 census of agriculture. General guides are given regarding drought probability and crop response. Sources of water supply are discussed, and methods of irrigation are given in general terms.

150. QUACKENBUSH, T. H. The job for soil conservation districts in humid area irrigation. Washington, U. S. Soil Conserv. Serv.,1956. 10 p. 1.96 Ad2Q2
Paper presented at 15th Annual Meeting of South Carolina Association of Soil Conservation District Supervisors, January 12, 1956.
To aid in evaluating conditions upon which profitable irrigation is dependent.

151. QUACKENBUSH, T. H. Quite a splash with sprinklers. Agr. Leaders' Digest 35(4):10-11. Apr.1954. 275.28 Am3
Of the 640,000 acres under sprinkler irrigation in the United States in 1950, 192,000 acres were in the 31 Eastern States. It is estimated that an additional 200,000 acres have been added in the 4 years up to 1954. The most important factors in successful humid-area irrigation are: 1, To get a system designed specifically to fit the conditions of the farm; and 2, to operate the system in accordance with the criteria used in the original design. With sprinkler equipment properly selected and properly operated, profits can be increased on most crops in the humid areas.

152. RANEY, W. A. Essential physical and biological considerations. (Sum.) Cotton Gin & Oil Mill Press 58(26):30-31. Dec.28,1957. 304.8 C822
Efficiency in an irrigation program is dependent on efficiency in: 1, Development of the water resource; 2, recharge of the soil-moisture reserves during rainfall-deficient periods; and 3, utilization of water by plants in the synthesis of tissue. Involved in this efficiency is the minimizing of losses, application efficiency, management of the moisture, and proper nutrient uptake by the crop.

153. REGAN, M. M., and GREENSHIELDS, E. L. Benefit-cost analysis of resource development programs. J. Farm Econ. 33:866-878. Nov.1951. 280.8 J822
A discussion of the use of benefits and costs in project evaluation. Irrigation and flood control are the principal benefits considered. The need for common standards and methods of evaluation between different agencies is emphasized.

154. RHOADES, H. F., and NELSON, L. B. Growing 100-bushel corn with irrigation. U. S. D. A. Ybk. Agr. 1955:394-400. 1 Ag84Y
Benefits of irrigation of corn vary widely from less than 6 bu. to over 110 bu. per acre in the humid area. Sprinkler irrigation is faced with the difficult problem of the moving of the pipe and sprinklers in tall corn. Strips of sod or low-growing crops such as soybeans have helped in making the job less difficult. It is essential that adapted hybrid varieties be used, soil fertility be maintained at a high level, and heavier planting rates be used with irrigation.

155. RICHARDS, S. J., and HUBERTY, M. R. Use of tensiometers in the irrigation of citrus. Amer. Soc. Hort. Sci. Proc. 67:210-214. June 1956. 81 So12
Concerns tensiometer studies in California, but applies equally to citrus irrigation in the East. Tests showed that irrigation of oranges, based on soil-moisture-tension measurement with tensiometers, rather than on seasonal rainfall estimates, produced the same results with less water. With the tensiometer method, only 22 in. of supplemental water was required to produce the same yield of oranges as 26 to 30 in. produced by the old method of calendar-schedule irrigations.

156. ROE, H. B. Moisture requirements in agriculture; farm irrigation. New York,McGraw-Hill,1950. 413 p. 55 R62
Covers all fields of irrigation information including engineering, soil and water relations, plant and water relations, and irrigation-farm management. All parts of the United States are considered but the West is given primary consideration. Costs and returns are considered throughout. Sprinkler irrigation is given only minor consideration.

157. RUBEY, H. Supplemental irrigation for Eastern United States. Danville,Ill.,1954. 209 p. 55 R82
This book brings together a wide variety of information

on methods of irrigation, sources of water, water requirements of crops, fertilizer needs, costs, returns, and considerations in getting started in irrigation in the Eastern States.

158. SANDALS, K. M. Aid available in the field of small irrigation projects. Washington, U. S. Soil Conserv. Serv., 1956. 8 p. A56.9 Sa5
Remarks made at the annual meeting of American Society of Agricultural Engineers, Roanoke, Va., June 18, 1956.
The Watershed Protection and Flood Prevention Act does not provide financial help with construction costs of structures used for irrigation or other water supply. P.L. 566 is limited to structures of less than 5,000 acre-feet storage capacity, and measures must benefit more than one individual farm or ranch. This means that at least part of the costs for irrigation structures must be paid locally without Federal help.

159. SEFEROVICH, G. H. Irrigation farming: Regional patterns and market prospects. Impl. & Tractor 71(14):30-32,83. July 14,1956. 58.8 W41
Figures show changes in number of farms irrigating and acres irrigated between 1949 and 1954, and region's percent of total irrigated acres in the United States. An irrigation index shows number of acres irrigated for each 10,000 acres of cropland harvested, cropland pastured, and improved cropland in each State.

160. SISSON, D. R., and WILLIAMS, G. G. Questions & answers on sprinkler irrigation. Mkt. Growers J. 84(5):36-37. May 1955. 6 M34
Includes a brief paragraph on costs: Initial investment ranges from $50 to $200 or more per acre, depending upon number of acres and expense in developing a water supply. Average initial cost per acre is from $75 to $100. Total cost per acre per year, including fixed and variable costs, ranges from $20 to $40. Fixed costs include depreciation, interest, taxes, and maintenance. Variable costs include labor and power.

161. SMITH, E. D. Insured irrigation loans. Burroughs Clearing House 39(9):35-37,88,90. June 1955. 284.8 B94
A newly authorized Federal program allows commercial banks to make loans for irrigation development in the humid area as part of the Farmers Home Administration guaranteed loan program. A Georgia bank has allocated up to $5,000,000 to aid farmers' credit needs for irrigation.

162. SNELL, A. W. Techniques employed in irrigation research. (Abs.) Assoc. South. Agr. Workers. Proc. 53:37-38. 1956. 4 C82
Methods of irrigation used on experimental plots vary a great deal. Sprinklers of different types are used depending on the size of the area being covered. Electrical resistance meters or tensiometers are probably the most common method of measuring soil-moisture content.

163. SNOW, B. C. Growth of eastern irrigation demands. Amer. Water Works Assoc. J. 47:226-229. Mar. 1955. 292.9 Am32J
In the Eastern States more and more farmers are realizing that it is cheaper to irrigate than to lose crops to drought. The water-rights problem that the Western States had to face years ago, is therefore now facing the Eastern States. In the West the water laws were developed chiefly for irrigation purposes, and a "prior appropriation" doctrine was adopted. The Eastern States still operate under the "riparian rights" doctrine of English common law, by which all properties bordering a stream or other body of water have equal rights to its use. This has presented a problem to irrigators, for whom water supply is the most important aspect of irrigation. South Carolina, Georgia, Alabama, Mississippi, Michigan, and Indiana have legislation pending to change the law, and other Eastern States are considering the subject.

164. SPRINKLE and save. Farm Mangt. 4:20,22,24. Jan.1955. 281.8 F2225
Although a carefully engineered flood-irrigation system may distribute water as efficiently as sprinklers, sprinklers will usually save water. These savings will not, however, be reflected in the power bill as the cost of maintaining the pressure required by the sprinklers will compensate for the saving in pumping less water. Growers have reported savings up to 50 percent when using sprinklers.

165. STALLINGS, J. H. Irrigation. In his Conservation, chap. 22. Englewood Cliffs, N. J., Prentice-Hall, 1957. 56.7 St1
The practice of irrigation is as old as civilization. The production of food supplies for our growing population is partially dependent on irrigation to meet the needs. Drought-hazard elimination by irrigation has increased yields at least 2 or 3 times in the West. Studies of water-use requirements of crops and climatological data indicate that for some crops nearly all sections of the country need irrigation at some time during the year. Water quality is discussed in some detail. Frequency and methods of determining when to irrigate are also discussed.

166. STEELE, J. C. The problem of irrigation. Amer. Nurseryman 102(5):16. Sept.1,1955. 80 Am371
Water supply is said to be the chief problem in irrigation. It takes 27,154 gal. to cover an acre 1 in. deep. A pump throwing 450 gal. per minute will pump this quantity in 1 hour. The State geologist should be consulted as to the quantity and quality of available water before irrigation is decided upon. With sufficient water, studies have shown that a typical 160-acre farm, having 80 acres under irrigation, will have approximately the same net income as a 320-acre dry farm.

167. TAYLOR, S. A., and SLATER, C. S. When to irrigate and how much water to apply. U. S. D. A. Ybk. Agr. 1955:372-376. 1 Ag84Y
Different crops are sensitive to moisture deficiency at different stages of growth. Generally it is at the time of most rapid vegetative growth or at time of germination or transplanting. Potatoes are sensitive until the tubers are fully formed; sugar beets are sensitive from the seedling stage until maturity. Field corn requires water at all stages but is particularly sensitive from silking time to hard-dough stage. Tobacco is sensitive at transplanting time and during the last month before maturity. It is a commonly accepted practice to irrigate when 60 percent of the available moisture is used.

168. THARP, M. M., and CRICKMAN, C. W. Supplemental irrigation in humid regions. U. S. D. A. Ybk. Agr. 1955:252-258. 1 Ag84Y
Gives initial costs, labor, fuel, operating, and other costs, of supplemental irrigation in the 31 Eastern States. Lists average increase in value per acre after irrigation of various crops in different States: Georgia, sweetpotatoes, $399.50; corn, $62; tomatoes, $133.50; cotton, $68.35. Virginia, tobacco, $282; corn, $122.40; pasture, $96.25; Missouri, cotton, $242.32; New York, potatoes, $50.96; Wisconsin, potatoes, $67.00.

169. THOMAS, E. L., and BRYAN, B. B. Uniformity of distribution of fertilizer materials when applied through sprinkler irrigation systems. Fayetteville, Ark. U. Dept. Agr. Engin., 1956. 31 p. 57.07 T36U
This article includes a discussion of corrosion of equipment by fertilizers applied through the system. In general the iron equipment was damaged considerably while the aluminum, brass, and copper were only very slightly damaged. Distribution of the fertilizer material was in direct relationship to the uniformity of the water distribution by the sprinklers.

170. THORNTHWAITE, C. W. We must irrigate scientifically. Amer. Veg. Grower 2(6):12-14. June 1954. 80 C733
"Hidden" drought in the Eastern States is as much of a hazard to the farmer as is drought in the West. Yet in 1950, in 25 Eastern States there were only 145,000 irrigated acres on 6,500 farms, while in 11 Western States 20,000,000 acres were irrigated on 250,000 farms. The error of the eastern farmer has been to irrigate when plants show distress, when often it is too late to make a good crop. The soil and not the plant should be watched for signs of distress. Evapotranspiration should be measured, and whatever is not promptly restored by precipitation should be supplied by irrigation. There will soon be on the market a simple and inexpensive kit containing an evapotranspiration-determining device, a rain gauge to measure precipitation, and a slide rule to tell the farmer when to irrigate.

171. THORNTON, J. F. Irrigation in the Southeast. Cotton Gin & Oil Mill Press 58:22,33. Jan.12,1957. 304.8 C822

Irrigation research with cotton in Mississippi, Arkansas, Missouri, Alabama, Georgia, and South Carolina has shown favorable results. In 1952 in Alabama irrigation increased the yield from 1,449 to 2,538 lb. per acre. In Arkansas from 1950 to 1952 the yield was increased from 1 bale to 1.57 bales. Yields at the Mississippi Delta Station increased with irrigation from 2,021 to 2,461 lb. of seed cotton per acre. Missouri reported in 1953 yields of 1,414 without and 3,458 lb. with irrigation. South Carolina reports increases of 655 lb. of seed cotton with irrigation. Georgia had an increase from 1,395 to 1,979 in 1954 with 4.66 in. of water. In 1955 the increase was from 2,383 to 3,104 lb. with irrigation. In 1956 the yield was 1,952 without irrigation, 3,306 lb. with 4.3 in. of water, 3,621 lb. with 5.8 in. of water, 3,463 lb. with 8.6 in. and 3,257 lb. with 11.2 in. of water. It is quite possible that too much water will depress yields. At the prevailing price of cotton this is an added income of $176.67 per acre. Added costs would be $2.50 per cwt. for picking and $3.50 per acre-inch to apply 5.76 in. of water per acre, or $20.16 per acre per irrigation. If 10 percent of Georgia's 904,813 allotted cotton acres were irrigated the practice would increase the net profits to farmers by about $14,398,000.

172. THURMOND, R. V. Sprinkler irrigation—what does it cost? Better Farming Methods 29(6):28,30-31. June 1957. 58.8 B46

Explains how to figure the annual costs of irrigation for any farm. Annual fixed costs include the rate of depreciation of the capital investment, interest on borrowed money, taxes, and insurance. Annual operating costs include expenditures for fuel or electrical energy, lubricants, costs of repairs and maintenance of equipment, and labor. All these added annual costs per acre, divided by the unit price of the crop produced, will give the yield per acre necessary to pay the annual irrigation costs. The increased yields must be more than the added annual costs, if irrigation is to be profitable.

173. TILESTON, F. M. Basic irrigation principles. Irrig. Engin. & Maintenance 4(9):12,29-30. Sept.1954. 55.8 Ir722

Consumptive-use rates of crops generally are slightly higher in the West than in the East. Peak use rates are generally encountered in late July or early August. Irrigation efficiency is the ratio in percent of the needed moisture to that applied. These efficiencies vary from 94 to 15 percent. Border-check irrigation is usually more efficient than the corrugation method.

173a. TONTZ, R. L. Future of irrigation in the humid area. J. Farm Econ. 40(3):636-652. Aug.1958. Ref. 280.8 J822

Primarily a discussion of future water supplies for irrigation in the 28 Eastern States exclusive of Florida, Louisiana, and Arkansas. In 1955 these States used 1,329.2 thousands of acre-feet of water for irrigation, and it is estimated that by 1974 this usage will triple or quintuple. Such increased needs would require either increased supplies of water, or a decrease in nonirrigation uses of water. Since there is little likelihood of a decrease in industrial and other nonirrigation uses, some new sources must be found. The author suggests conversion of salt water to industrial uses, and artificial rainmaking, as possible solutions.

174. TOWERY, J. D. HESSLER, L. E., and POWER, B. K. How are cotton fiber characteristics and spinning performance affected by irrigation? Textile Indus. 118(3):149-151,153. Mar.1954. 304.8 C823

Aside from the fact that irrigated cotton plants produced 3 times as much cotton as did unirrigated plants, tests showed these further effects of irrigation on cotton: It required 88 bolls of unirrigated cotton to make a pound, compared to only 80 bolls for irrigated cotton; staple length of irrigated cotton was greater than that of unirrigated, varying from 1/8 in. longer in some varieties, to 1/16 in. longer for others; yarn strength was greater with the irrigated cotton, owing to the increased length and the greater fineness of the fiber.

175. U. S. BUR. OF RECLAMATION. Irrigation advisers' guide. Washington,1951. 216 p. 156.85 Ir73I

Designed primarily for use in the West, but applies to humid-area irrigation in some aspects. Covers water requirements of crops, amounts and frequencies of irrigation, land preparation for surface irrigation, and methods and types of irrigation systems.

176. U. S. BUR. OF THE CENSUS. 1950 census of agriculture. Volume III. Irrigation of agricultural lands. Washington,1952. various paging. 157.4 C173

State reports are given for 20 States (17 Western States and Arkansas, Louisiana, and Florida) with data for counties and drainage basins and a summary for the United States. Included are numbers of enterprises, irrigation works and equipment, source of water, new capital investment since 1940, cost of irrigation water, number of farms and acreage irrigated, and quantity of water used for irrigation purposes.

177. U. S. BUR OF THE CENSUS. 1950 census of agriculture. Volume V. Special reports. Part 7. Irrigation 1950, a graphic summary. Washington,1952. 35 p. 157.41 C332

This is one of the graphic summaries based on data from the 1950 and prior censuses of agriculture. It is limited almost entirely to the 17 Western States and Arkansas, Louisiana, and Florida. Some of the significant facts regarding agriculture in irrigated areas are presented graphically. Main emphasis is given to acreages irrigated, number and types of enterprises, sources of irrigation water, capital investment, costs of irrigation water, land use, tenure, and percentages of production coming from irrigated land.

178. U. S. BUR. OF THE CENSUS. United States census of agriculture: 1954. Volume III. Part 6, Irrigation in humid areas, a cooperative report. Washington,1956. 121 p. 157.41 C3324

This report presents data obtained by a special mail survey of irrigated farms in 28 Eastern States on acres irrigated in 1954 and 1955. Data is shown on number of farms irrigated, acreage irrigated, crops irrigated, number of times each crop is irrigated, year irrigation began, method of applying water, source of power, source of water, use of pumps and reservoirs, and investment costs of the irrigation system. This data is shown on a total and State basis. Usable data was obtained from 64 percent of the farms reporting irrigation in the 1954 census of agriculture and covering 93 percent of the acreage.

179. U. S. FARMERS' HOME ADMIN. Minimum standards for planning and construction of farm irrigation systems. Washington? n.d. 18 p. 1.949 M66

Includes instruction on how to compute fixed and operating costs, with an example giving breakdown of costs for each item.

180. U. S. SOIL CONSERVATION SERV. Water facts; sources, supply, needs, uses, losses, flood, conservation. U. S. D. A. PA-337,12 p. Aug.1957. 1 Ag84Pro

A quick survey of the entire water-supply and use picture for the United States. About 79 billion gal. of water daily were used for irrigation in 1950 of a total for all purposes of 174 billion gal. By 1955 this daily use had risen to 211 billion gal. for all purposes of which 81 billion was for irrigation. The estimated need in 1975 is for 350 billion gal. for all purposes of which 110 billion gal. daily is for irrigation.

181. VAN BAVEL, C. H. M. Estimating soil moisture conditions and time for irrigation with the evapotranspiration method. U. S. Agr. Res. Serv. ARS-41-11, rev.,16 p. Jan.1957. A56.9 R31

A bookkeeping system has been devised as a guide in knowing when to irrigate various crops. It is necessary to know the available-moisture-holding capacity of the soil in the root zone of the crop being considered and the rate of use by the crop, commonly called the evapotranspiration rate. This system is compared with results from actual measurement and from the Thornthwaite and Blaney-Criddle formulas and has been found quite satisfactory.

182. VAN BAVEL, C. H. M. Evapotranspiration the ET method; a new way to find a right time for irrigation. Better Farming Methods 28(4):14,16. Apr.1956. 58.8 B46
Description of a method for determining soil-moisture content by estimating the amount of water lost from the soil each day by evaporation and plant transpiration. This method is very useful in determining when to irrigate. Essentials in this method are a rain gauge and knowledge of available-moisture-holding capacities of the soil and water-use rates of the crop.

183. VAN BAVEL, C. H. M. Sprinkler or surface irrigation: Which is best for use in humid areas of the East? Better Farming Methods 28(12):30-31. Dec.1956. 58.8 B46
The most economical type of irrigation must be decided by the factors involved. On farms where there is an ample water supply, where the acreage to be irrigated is large, where the land is flat and the soil deep, and where the profit margin is small, surface irrigation might be the most economical solution. But if water is at a premium, and the irrigated acreage is small, if the land is rolling or sloped, and if high-value crops are to be raised, sprinkler irrigation would be more economical in the long run.

184. VAN BAVEL, C. H. M. What irrigation may mean to you. Hoard's Dairyman 98:436-437. May 10, 1953. 44.8 H65
Summer droughts occur in the humid East when total rainfall is less than plant transpiration, and when the rainfall is unevenly distributed. In the Northeast there are, on the average, 14 days every summer when lack of soil moisture limits plant growth; in the Southeast, 35 days. It is a waste of both time and money, however, to irrigate poor pasture. Increased fertilization will be necessary, as increased production of forage naturally increases the rate of depletion of nutrients from the soil. Pasture yields were increased 39 percent in 1951 and 89 percent in 1952 by irrigation.

185. WARE, L. M. Irrigation research on vegetable crops in the South. (Abs.) Assoc. South. Agr. Workers Proc. 47:172-173. 1950. 4 C82
Lists the types of studies made in Georgia, Tennessee, Mississippi, Oklahoma, Florida, Alabama, and by the Tennessee Valley Authority. General results indicated: "That irrigation generally increased yields and gave high increases in gross and net returns in years or periods of inadequate rainfall but little or no increases in years when rainfall was adequate. In a few instances irrigation actually decreased yields. Estimated values for increases (or losses) from irrigation ranged from a loss of $65 per acre to profits above irrigation costs usually ranking from $50 to $150 per acre," -p.173.

186. WELLS, J. V. B. Surface water resources. Amer. Soc. Civ. Engin. Proc. 83(SA3,1272),9 p. June 1957. 290.9 Am3Ps
The importance of water, frequency of drought, distribution of runoff, and development of water supplies are discussed in general terms. The East has a very great potential for expansion of irrigation.

187. WERLY, E. F. The use of sprinkler irrigation systems for waste water disposal. Irrig. Engin. & Maintenance 8(1):21-27. Jan.1958. 55.8 Ir722
The shortage of fresh, unpolluted water and the disposal problem of polluted waste water have increased the use of waste water for irrigation. The first known use of waste water through sprinklers was at the Hanover Canning Company in Pennsylvania in 1947. Twenty-two plants were using this method in 1951. In May 1957, in Wisconsin alone, 48 of 126 canning factories were using irrigation systems for waste-water disposal.

188. WHEN should I irrigate? Farm Q. 9(2):76-77, 86,88-89. Summer 1954. 6 F22995
Field capacity, wilting point, amount of water withdrawn by the crop, speed with which the farmer can cover the field, depth of root zone of crop, all help to determine when to start and stop irrigating. Several moisture-testing devices are described with costs and manufacturers' names given.

189. WHITE, J. W. Cost and management problems. Cotton Gin. & Oil Mill Press 55(17):59-60. Aug.14,1954. 304.8 C822
The original cost of a sprinkler system for 100 acres will be about $76 per acre using well water and electric pump, and about $44 per acre using free surface water. For furrow or flush irrigation the original cost would be $40 per acre using a well, and $27 per acre using free surface water. For cotton irrigation, the original system will cost close to $76 per acre for 100 acres, or $7,600 in all. Irrigation increases yield on the average by 200 lb. of lint and 344 lb. of seed per acre. The price of lint would have to drop from its present $.33 per pound to $.17 per pound before irrigation of cotton would cease to be profitable.

190. WHITT, D. M., and VAN BAVEL, C. H. M. Irrigation of tobacco, peanuts, and soybeans. U. S. D. A. Ybk. Agr. 1955:376-381. 1 Ag84Y
Irrigation of tobacco from Connecticut to Florida has shown yield responses from 100 lb. to 500 lb., or about 5 to 25 percent. One of the best uses of irrigation on tobacco is a light application after transplanting. About 27,890 acres of tobacco were irrigated in 1954. Virginia reports yield increases from 1,529 to 2,642 lb. per acre with irrigation. Most of the soybean irrigation in 1954 was in Arkansas and Nebraska. Yield increases with irrigation average about 25 percent but may vary from 0 to 80 percent. The actual increase is usually about 7 to 8 bu. per acre.

191. WILLIAMS, D. A. Our fresh water supply—Nation's newest critical resource. United Fresh Fruit & Veg. Assoc. Yearbook 1958:160-165. 280.3939 Un3
Estimates are that the total daily precipitation on the United States is about 4,300 billion gal. per day. About 70 percent is used in evaporation and transpiration by plants and the remainder of about 1,200 billion gal. daily is streamflow. Total withdrawal for domestic use, industry, and irrigation is about 211 billion gal. daily. In 1955 about 123 million acre-feet were used for irrigating 34 million acres. About 32 million acre-feet of this was lost in conveyance to the farms. Irrigation used about 77 billion gal. daily in 1950, 81 billion in 1955, and estimated need is for 110 billion gal. daily in 1975.

192. WILLRICH, T. How to select an irrigation unit. Co. Agent & Vo-Ag Teacher 11(5):24-26. May 1955. 275.28 N213
The most important points to remember in selecting an irrigation system are to be sure of adequate water supply during the expected dry spell, get irrigation plans from several dealers if possible, get advice from impartial persons familiar with the problems or who are experienced with irrigation, and get a system that is designed to work as a unit. This will usually mean buying the entire system from the same dealer.

193. WILSON, T. V. Select the right power unit for your irrigation pump. Hoard's Dairyman 100:714,728-729. Aug.10,1955. 44.8 H65
Economic considerations are included. A breakdown of initial and operating costs of 3 power units are given in tables: The initial cost of an electric motor ranges from $199 for a 3-hp. motor to $470 for a 25-hp. motor; annual fixed costs (on a 20-year life) range from $32 to $173; and operating costs (at .015 per kw.-hr.) range from $16 to $135 per year. The initial cost of a gasoline engine ranges from $80 for a 3-hp. engine, through $550 for a 25-hp., to $2,200 for a 100-hp.; annual fixed costs (on a 10-year life) range from $38 to $909; annual operating costs (at $.19 per gal.) range from $27 to $623 based on 360 hours of operation. Initial cost of a diesel engine ranges from $1,400 for a 30-hp. engine to $3,400 for a 100-hp.; annual fixed costs (on a 10-year life) range from $294 to $817; operating costs (at $.15 per gal.) range from $112 to $375 per year for 360 hours of operation. In general diesels are cheaper than gasoline engines if over 50 hp. is needed. This difference is even greater if the diesel is used more than 360 hours annually.

194. WOOD, I. Land-leveling for irrigation. Better Farming Methods 29(4):54,57. Apr.1957. 58.8 B46
Covers planning, location of water supply, land surveying, and costs. Costs are said to run from $35 to $85

or more per acre when performed with large earth-moving equipment, less when done a little at a time by the farmer in his spare time.

195. WOOD, I. D. Irrigation's spread in the Cotton Belt. Cotton Gin & Oil Mill Press 57(7):55,68-69. Apr.7, 1956. 304.8 C822
Drought, rising cost of production, emphasis on portable sprinkler equipment and spread of information on the advantages of irrigation are causes for its increased use. Discussion of water supply, methods of application, hints on buying a sprinkler system, approximate costs, and good management practices. First costs of land leveling may range from $25 to $72 an acre. Gravity methods are the least expensive. First cost of sprinkler system is from $45 to $95 per acre, overhead costs vary from $6 to $18 per acre; operating costs are estimated at $2 per acre-inch of water applied.

196. WOOD, I. D. Physical essentials. Cotton Gin & Oil Mill Press 55(17):54,56. Aug.14,1954. 304.8 C822
Physical essentials to sprinkler irrigation in the East and South are water supply and properly designed equipment. For gravity irrigation, the slope and lay of the land are important considerations. Discusses wells, pumps, land preparation, application, equipment, etc., but gives no costs.

197. WOODING, N. H. Equipment needed for irrigation. Hoard's Dairyman 99:541,558-559. June 10,1954. 44.8 H65
Planning an irrigation system requires locating an adequate water source, selecting the fields and crops to be irrigated, and designing the equipment to meet the particular needs. A diesel power unit needs to be operated at least 800 hours per year to be more economical than a gasoline engine.

198. WOODING, N. H. How to irrigate for best results. Hoard's Dairyman 99:624-625. July 10,1954. 44.8 H65
Irrigation requires good crop management. Irrigation should be done when the dry spots in the field are beginning to suffer from lack of water. Enough water should be applied to bring the entire root zone back to field capacity. The irrigation water should not be applied so fast that runoff occurs. Bare soil will not absorb water as fast as that having plant cover.

199. WOODING, N. H. What does it cost to irrigate? Hoard's Dairyman 99:587,596. June 25,1954. 44.8 H65
A recent survey in an Eastern State showed costs of developing water sources averaged $1,113 per farm and ranged from $10 to $8,000. Equipment cost averaged $5,500 per farm. Annual overhead costs ranged from 9 to 15 percent of the original investment. Operating costs for fuel, labor, and repairs averaged $4.02 per acre-inch and ranged from $1.12 to $14. The average total cost per acre-inch was $13.40 and ranged from a low of $2.74 to a high of $51.

200. WOODING, N. H. What to consider before irrigating. Hoard's Dairyman 99:499,510. May 25,1954. 44.8 H65
Five things to consider before buying an irrigation system are: Water supply; legal restrictions on the use of stream water; fields to be irrigated; crops to be irrigated; how to buy an irrigation system. Cites successful and profitable uses of irrigation on pastures in Tennessee and Georgia. In Tennessee irrigated pasture produced 49 percent more grazing days, and 54 percent more milk. In Georgia, irrigated pasture increased grazing period by 92 days.

201. WOODWARD, G. O. Increasing production with irrigation. Mkt. Growers J. 85(9):20. Sept.1956. 6 M34
Sprinkler irrigation has increased from 250,000 acres in 1946 to over 5,000,000 acres in 1956. The advance has been as rapid in the humid East as in the dry areas, because the high-value crops make it pay when short drought periods occur. As many bushels of potatoes were produced in the United States on 1,500,000 acres in 1953 as were produced on 3,700,000 acres in 1909. Moisture control was one of the factors involved in this increased production.

202. WORMLEY, G. W. Corn irrigation—they're making it work. Farm J. 78(6):32-33,136-137. June 1954. 6 F2212
Midwestern and eastern farmers report that the initial cost of a sprinkler system is from $50 to $150 an acre; operating costs are from $20 to $30 per acre; fixed costs usually range from 5 percent to 15 percent of the initial cost.

203. WORMLEY, G. W. Water—enough to irrigate? Farm J. 79:23,109. Jan.1955. 6 F2212
Suggestions on how to save and use all the water you can get. A nearby stream is the cheapest and easiest source; also explore the possibility of having wells dug above underground water-filled riverbeds; use underground gravel beds or "aquifers" and reservoirs.

NORTH ATLANTIC STATES

204. ALDERFER, R. B. Forage crop irrigation. Holstein-Friesian World 52:486. Mar.5,1955. 43.8 H742
At a cost of $5 or $6 per acre-inch, and with 3 to 5 acre-inches necessary to produce an increase in growth, forage irrigation is uneconomical in New Jersey. It would cost at least $20 to produce $15 to $20 worth of forage. However, vegetable-crop irrigation has proved itself of great value, and forage-crop irrigation may be justified in emergencies if the equipment already on hand for vegetable irrigation can be diverted temporarily to the forage crop.

205. ANDERSON, P. J. Effect of soil fumigation and irrigation on fire holding capacity of tobacco leaves. Larvacide Log 11:19-20. Jan.1950. 421 L32
Tests of fire-holding capacity of tobacco at the Windsor [Conn.] Experiment Station indicate a definite improvement where the tobacco is irrigated. The average of the tests was 22.4 seconds for the unirrigated and 30.3 seconds for the irrigated. This verifies a well known fact that tobacco during a dry year has poorer burn than during a wet year. Soil fumigants such as ethylene dibromide seem to improve fire-holding capacity but DD has a tendency to decrease fire-holding capacity.

206. ANDERSON, P. J., and SWANBACK, T. R. The irrigation experiment of 1944. In Johns-Manville Corporation. Supplemental irrigation, p. Conn. 1-3. New York, 1951. 55 J62
In studies at the Tobacco Substation of the Connecticut Agricultural Experiment Station, 6 plots were set aside to receive no supplemental water and no nitrate; 8 plots received three 2-in. applications of water, with no nitrate; and 8 plots received similar irrigation, with added nitrate. The tobacco from the 6 control plots had short leaves of poor elasticity and color, and no quality; the tobacco from the irrigated, unnitrated plots had larger leaves, but many were yellow and lifeless; while the tobacco from the irrigated, nitrated plots had leaves of good size, color, and quality. The yield increased from 1,526 lb. per acre on the unirrigated, unnitrated plots to 1,726 lb. per acre on the irrigated unnitrated plots, to 1,990 lb. per acre on the irrigated, nitrated plots. The relative crop value was almost doubled by water and nitrate.

207. APP, F. Should we invest in irrigation for Eastern agriculture? N. Y. State Hort. Soc. Proc. 101: 72-79. 1956. 81 N484
The number of acres irrigated in New York has grown from 19,248 in 1949 to 59,024 in 1954, and in New Jersey from 28,117 to 58,012 in the same period. The average initial cost of sprinkler irrigation in these States is $150 per acre. At Seabrook Farms in New Jersey in 1953 it was found that irrigation had a greater effect on yields of sweet corn than did added fertilizers. Plots fertilized but not irrigated yielded 3,364 lb. per acre, whereas plots irrigated but not fertilized yielded 4,700 lb. per acre. Plots with both irrigation and extra fertilizer yielded 5,400 lb. per acre. In 1955 irrigation alone increased corn yields from 2.15 to 3.41 tons per acre. The irrigated corn sold for $28.91 per ton, compared to $26.11 per ton for the unirrigated. With irrigation costs amounting to $25.94 per acre ($12.60 for labor, and $13.34 for fixed and other operating costs), the net profit was $72.64 per acre for the irrigated corn, and $56.14 per acre for the unirrigated.

208. BANTA, E. S. Are you planning to irrigate? Amer. Veg. Grower 4(6):12-13,29. June 1956. 80 C733
Using farmer experiences as illustrations, guides to aid in the development of an efficient system of irrigation are discussed. A New York farmer who grows several hundred acres of vegetables invested $35,000 in a system in 1949. It costs him $7 to $8 for labor, power, and interest on overhead to apply an acre-inch of water. At an irrigation cost of $21 per acre, yield of 3 tons of snap beans per acre was realized by a Maryland farmer, while unirrigated fields made less than a ton per acre. Tomato yield was increased by 3 tons per acre with a $7 investment in water. Irrigation costs generally range from $60 to $125 per acre including pump, pipe, fittings and sprinklers for 50 or more acres, but not including the cost of drilling a well or building a pond.

209. BARR, W. L. Economic aspects of irrigation. (Abs.) Canning Trade 77(31):8-9. Feb.21,1955. 286.83 T67
On 53 Pennsylvania farms in 1949, capital outlay for irrigation systems ranged from $1,500 to $15,000, and averaged $5,560. Average cost of applying an acre-inch of water was $13.40, of which 70 percent was fixed costs and 30 percent was variable costs. The lowest cost per acre-inch was $2.75, on a farm where many factors combined to keep costs down. Water was plentiful and free, and its source was adjacent to and level with the field irrigated; all water was applied to one 70-acre field; and labor costs were kept down by applying a maximum amount of water at each irrigation, obviating the frequent moving of the laterals.

210. BARR, W. L., and THOMAS, D. W. Irrigation on Pennsylvania farms. Pa. Agr. Expt. Sta. B. 562,30 p. Jan.1953. 100 P381
A study of 53 irrigated farms in Pennsylvania in 1949 revealed the following data: Eighty-seven percent of irrigation was of field crops, orchard, and pasture; 70 percent of all irrigation was of potatoes; 4 percent was of orchards; average investment was $5,560; average fixed cost was $650 per year per farm; average cost per acre-inch was $13.40; and the cost of irrigating 1 acre 1 time was $18.85. Forty-five percent of farmers reported 21 percent to 40 percent increase in production after irrigation; 19 percent reported 41 percent to 60 percent; 2 percent reported 61 percent to 80 percent; and 6 percent reported 81 to 100 percent increase in production. Investment-cost breakdown shows 80 percent in equipment and 20 percent in source of water. Distribution of labor and tractor hours by operations is shown.

211. BARTON, L. W. Should I irrigate my crops? N. J. State Hort. Soc. Hort. News 31:2269-2271,2273,2286. May 1950. 81 N46
Irrigation pays handsome dividends in New Jersey on all vegetables on good land, on small fruits, and most of the large fruits. Part of the increase is in better quality as well as increased yields. Sprinklers have also served very well for frost control on strawberries, blueberries, cranberries, and peaches.

212. BERG, G. L. The farmer can control the weather. Co. Agent & Vo-Ag Teacher 10(4):9-10. Apr. 1954. 275.28 N213
A description of the system of determining when to irrigate developed by Dr. C. W. Thornthwaite, head of the Laboratory of Climatology at Seabrook, N. J. It is essentially a circular slide rule showing the available-moisture-holding capacity of the soil in the root zone of the particular crop. Subtractions or additions are made to this balance based on daily plant needs and any amount added by rain or irrigation. When the supply is exhausted it is time to irrigate. This is not an absolutely accurate determination and should be used only as a guide

213. BERG, G. L. Scientific irrigation can really pay! Co. Agent Vo-Ag Teacher 11(5):12-13. May 1955. 275.28 N213
Farmers in Gloucester County, N. J., found that a special weather service was most helpful along with Dr. Thornthwaite's irrigation guide in determining when and how much to irrigate. Records have shown that on most vegetables irrigation should be applied before the crop reaches the wilting stage.

214. BINGHAM, C. H. Irrigation on dairy farms. Pa. Dairymen's Assoc. Rpt. 29:16. 1954. 44.9 P384
Equipment costs for irrigation of pasture or forage crops in Pennsylvania range from $80 to $125 per acre irrigated. Operating costs range from $1.12 to $14 per acre-inch depending on size of system, pressure, amount of use, etc. Average costs of a well designed system should be about $3.00 per acre-inch. Fixed or overhead costs will vary from $.87 to $37 per acre irrigated. Increases in yields at Penn State University have been about 33 percent for a 3-year period. A Fulton-County farmer increased corn yield from 51.6 to 119 bu. per acre with irrigation. At $1.50 per bu. after deducting cost of irrigation the increased net return was $83.30 per acre. A Mechanicsburg farmer irrigated 15 acres of pasture and pastured 36 head of dairy cattle for 3 months in 1953, while adjoining unirrigated pasture produced nothing. The hay equivalent would be 17 tons per month. With hay at $40 per ton, his estimated net gain after deducting operational costs was $27.55 per acre per month.

215. BLAKE, G. R. Some things to consider in irrigating tomatoes. N. J. Ten-Ton Tomato Club. B. 21: 23-25. 1954. 81 T253
In New Jersey during 2 normal growing seasons farmers can expect about 6 periods of 10 to 15 days without rain, another 2 periods of 16-20 days without rain, and still another period that exceeds 20 days. The amount of irrigation water to apply varies with the soil texture and time of the year, between .75 and 2.5 in. per acre.

216. BLAKE, G. R., BRILL, G. D., and CAMPBELL, J. C. Studies on supplemental irrigation of potatoes in New Jersey. Amer. Potato J. 32:327-331. Sept.1955. 75.8 P842
Results of two experiments at the Vegetable Research Farm of the New Jersey Agricultural Experiment Station, New Brunswick: 1, Effect of different amounts of water applied at various depletion levels resulted in yields which varied from 290.6 bu. per acre with no irrigation to 433 bu. per acre irrigated in 1953, and from 292.9 to 514.6 in 1954; yield increases with all irrigation treatments averaged 41.3 percent in 1953, and 70.5 percent in 1954; 2, an experiment on the long-time effects of potato irrigation resulted in increases ranging from 15 bu. to 228 bu. per acre for the 9-year period 1946-54.

217. BOND, M. C., and VROMAN, H. B. Relationship of irrigation and other practices to yields of potatoes, eastern Long Island, 1949. N. Y. Agr. Col. A. E. 722,rev., 18 p. July 1950. 281.9 C81
In 1949, a dry year, potato farmers on Long Island got large increases in both yield and quality through irrigation. Without irrigation the average yield was 160 bu. per acre, of which 68 percent graded No. 1. With 4.1 in. of water in from 1 to 3 irrigations, average yield was 298 bu., of which 81 percent graded No. 1. With 5 to 7 irrigations of a total of 9.8 in. of water the yield was 402 bu., of which 87 percent was No. 1. There was some difference between different varieties but not a great deal. This survey covered 245 farmers in the area.
Summary in N. Y. Agr. Col. Farm Econ. 177:4594-4596. Nov.1950. 280.8 C812

218. BOYD, W. I. Short-cuts through modern methods. New Eng. Homestead 124(17):14,41. Sept.8,1951. 5 N442
Applying fertilizer and fungicides through irrigation water to tobacco-plant beds and potato crops in Connecticut.

219. BRADLEY, G. A., and PRATT, A. J. Irrigate to make a crop—not to save it. Farm Res. 20(2):10-11. Apr.1954. 100 N48A
Studies by the Cornell Department of Vegetable Crops, on the effects of time of irrigation on the yield of potatoes and onions at 3 separate points in New York, gave the following average results in bushels per acre: Onions — not irrigated, 520; irrigated when soil moisture had dropped to 5 percent, 690; irrigated when soil moisture had dropped to only 50 percent, 910. Potatoes — not irrigated, 513; irrigated at 5 percent of available soil moisture, 581; irrigated at 25 percent of available soil moisture, 613; and irrigated at 50 percent of available soil moisture, 713.

Also in Canning Trade 76(46):7-8. June 7,1954. 286.83 T67; and in Amer. Veg. Grower 2(6):10,15. June 1954. 80 C733; and in Better Farming Methods 27(5):24-26. May 1955. 58.8 B46

220. BRADLEY, G. A., and PRATT, A. J. The response of potatoes to irrigation at different levels of available moisture. Amer. Potato J. 31:305-310. Ref. Oct.1954. 75.8 P842
In 1952 and 1953 at Ithaca, N. Y., potatoes were irrigated when the available-moisture content of the soil dropped to 50 percent, 25 percent and 5 percent. One plot was unirrigated. Comparisons were made on the basis of number of tubers set and size of the tubers. Size and yields were increased most by irrigation when available moisture reached 50 percent. Indications were that the plots receiving more water needed more fertilizer late in the season. Yields averaged 713 bu. per acre with irrigation at the 50 percent level, 613 bu. at the 25 percent level, 581 bu. at the 5 percent level, and 525 bu. per acre where not irrigated.

221. BRILL, G. D., and BLAKE, G. R. Irrigation may increase runoff in humid areas. Agron. Abs. 49:44-45. 1957. 241 Am39
In New Jersey, during 4 out of 7 years, runoff was 25 to 60 percent higher with irrigation than without. During extreme droughts when there is no plant cover on unirrigated areas the runoff is higher from the unirrigated plots.

222. BROWN, B. A. Does irrigation pay? Conn. Veg. Growers' Assoc. Proc. 37:41-43. 1949. 75.9 C76
Gives approximate costs of irrigation in Connecticut and concludes that in most cases irrigation does not pay. Costs, excluding water, are: Initial costs, including pump, engine, pipe and fittings, and nozzles — $4,000; annual fixed costs — $32 per acre; annual operating costs — fuel, $1.25 for each 1 1/2-in. application per acre; labor — $2 per application per acre, or $3.25 per acre for each application.

223. CAMPBELL, J. C. Irrigation increases income. In Johns-Manville Corporation. Supplemental irrigation, p. N. J. 1-2. New York,1951. 55 J62
Research on potato irrigation in New Jersey in 1944 with a rotating sprinkler system. The initial cost of equipment was $39 per acre, fixed annual costs were $6.20 per acre, operating costs were $11.50 per acre, and the extra cost for labor in harvesting and packing the increased yield was $21.20 per acre. The average increase in yield due to irrigation was 88 bu. per acre. At $1.65 per bushel the gross increased income was $145 per acre. Subtracting the irrigation costs and the extra labor costs, the net increased income was $106.10 per acre.

224. CAMPBELL, J. C. Irrigation is insurance. In Johns-Manville Corporation. Supplemental irrigation, p. N. J. 3-5. New York,1951. 55 J62
Experiments at the New Jersey Agricultural Experiment Station in 1949 with irrigation of potatoes planted with various spacings. The summer of 1949 was very hot and dry, and a total of 9 applications of 1 to 1.5 in. of water were made, with rotating sprinklers, in June, July, and August. Irish cobblers spaced at 8 in. yielded 135 bu. of No. 1 grade potatoes, compared to 355 bu. per acre for the irrigated potatoes. Spaced at 10 in. the yield was 133 bu. irrigated to 113 unirrigated. At 12 in. the yield was 307 to 70. The 12-in. spacing brought the greatest difference in yield between irrigated and nonirrigated crops, the 10-in. spacing brought the least difference, and the 8-in. brought the greatest total yield of No. 1 grade potatoes from both irrigated and nonirrigated crops.

225. CAPUS, J. P. Portable systems popular in N. J. Mkt. Growers J. 81(6):26,29. June 1952. 6 M34
Typical yields of truck crops are: Irrigated tomatoes yielded more than 14 tons per acre, unirrigated test rows on edges of field yielded practically no crop; 1951 winner of the top yield award produced 25.95 tons of tomatoes per acre with irrigation. Other growers using irrigation reported between 16.10 and 18.50 tons per acre, and between 13.92 and 11.39 tons per acre. Cost of portable irrigation averages about $100 per acre for more than 50 acres, often higher for smaller acreages.

226. CORNELL UNIVERSITY. COLLEGE OF AGRICULTURE. DEPT. OF AGRONOMY. Irrigation of pastures and meadows. Cornell U. Col. Agr. Dept. Agron. Mimeo. 945,6 p. Jan.27,1954. 276 C813
Tests at the Arnot Forest Experiment Station in New York, with irrigation of pastures, showed that low-fertility irrigated pastures yielded less dry matter (2.11 tons per acre) than did high-fertility unirrigated pasture (3.59 tons). Irrigated high-fertility plots yielded 3.64 tons per acre. In 2 series of tests at Cornell, irrigation increased pasture yield by an average of .63 tons per acre per year in 1 test, and by an average of .65 tons in the other. In all tests irrigated pasture was more uniform, and the plants were more succulent and more stimulating to milk production. The initial investment in equipment was $75 to $125 per acre. At an average cost of $100 per acre, fixed costs were $15 per acre per year, and labor and fuel costs were $2.40 per acre per year per 1 1/2-in. application, a total of $17.40 per application per acre per year.

227. CROSS, C. E. Discussion on cranberry bog irrigation. Cranberries 17(10):7-8. Feb.1953. 80 C852
Discusses 3 methods of bog irrigation and concludes that none of them is satisfactory. Sprinkler irrigation at $600 to $1,200 per acre is too expensive. Portable sprinkler irrigation is less expensive, but requires too much labor and trampling of the soil, and also eliminates the frost protection afforded by a complete system. Ditch irrigation is helpful, but when severe drought comes along it is inadequate. Flash-flooding, particularly of young plants, is hazardous. It may cause drowning of the plants, or spread of fruit rot and infection.

228. DONAHUE, R. L. Water; a critical factor in crop production. N. H. Agr. Expt. Sta. Prog. Rpt. 2(3): 12-13. May 1956. 100 N452
Irrigation of forage at Durham, N. H., increased the dry-matter yields from 1,238 lb. per acre to 3,288 lb. annually for the years 1949-50 and 1952-53. There was adequate rainfall in 1952 so that no irrigation was needed. Irrigation increased the yield by an average of 196 percent. The range was from 44 to 726 percent increase.

229. DRINKWATER, W. O., and JANES, B. E. Effects of irrigation and soil moisture on maturity, yield, and storage of two onion hybrids. Amer. Soc. Hort. Sci. Proc. 66:267-278. Ref. Dec.1955. 81 So12
Experiments at the Connecticut Agricultural Experiment Station involving 4 levels of irrigation in 1952 and 1953. Treatments were: 1, No irrigation; 2, heavy and infrequent irrigation (1 in. every 10 to 12 consecutive rainless days); 3, light and frequent irrigation (1/4 in. every 4 to 5 rainless days); and 4, heavy and frequent irrigation (1/2 in. every 4 to 5 rainless days). Maturity of the onions was delayed in direct ratio to the amount of irrigation. Treatments 2 and 3 delayed harvesting time 11 days beyond the harvesting time of the unirrigated onions, and treatment 4 delayed harvesting 19 days. Yield increased with increased irrigation, the nonirrigated onions yielding an average of 6.4 tons of U. S. No. 1 onions per acre; treatment 2 yielding 10.4 tons; treatment 3, 10.2 tons; and treatment 4, 12.4 tons. However, the percentage of defective onions increased with irrigation, from 5.1 percent with no irrigation to 19.5 percent with heavy and frequent irrigation (treatment 4). Defects due to storage, on the other hand, were greater with the nonirrigated onions than with the irrigated. Weight loss during storage progressed from a low of 22 percent with treatment 4 to a high of 35 percent with treatment 1 (no irrigation).

*230. DRINKWATER, W. O. Timing irrigation effectively. Conn. Veg. Growers' Assoc. Proc. 43:29-30. 1956. 75.9 C76

231. ELLISON, J. H., and JACOB, W. C. Further studies concerning the influence of irrigation on the nitrogen, phosphorus and potash requirements of six potato varieties. Amer. Potato J. 31:141-151. May 1954. 75.8 P842
At the Long Island Vegetable Experiment Station the response of potatoes to irrigation was very pronounced in 1949 and in 1952, but was much lower in 1950 and 1951. In 1949 the average of all fertilizer levels

*Not examined.

showed a yield increase with irrigation of 206 bu. per acre and in 1950 the increase was only 10 bu. The average without irrigation in 1951-52 was 281 bu. per acre, and 383 bu. with irrigation. These experiments show that to get the best fertilizer response it is essential to have adequate moisture present in the soil.

232. ELLISON, J. H. How the Long Island "rain makers" irrigate. N. J. Farm & Gard. 24(12):38-39. Dec.1953. 6 G162
At the Long Island Vegetable Research Farm, Riverhead, N. Y., irrigation increased potato yields in the dry years of 1939,1944, 1949, and 1952 an average of 172 bu. per acre; during normal years 1940 to 1951, an average of about 20 bu. per acre. Ten-gal.-per-min. nozzles were used mainly, to apply about 1 1/2 in. of water every 10 days during dry weather, at the rate of 1/2 in. per hour.

233. FOSS, R. E. Pasture irrigation in grassland farming. New Eng. Homestead 123(23):23-25. Dec.9,1950. 6 N422
Some of the benefits of pasture irrigation in New England are discussed. In one case, pasture irrigation increased milk production over 33 percent. In another instance, the daily cost of feeding a 70-cow herd was reduced from $54.60 to $7.31 after irrigation. Without irrigation the average grazing rate was 1 1/2 cows per acre; after irrigation as many as 6 cows could graze on 1 acre. This reduced the walking done by the herd and increased milk production. Irrigation was found, also, to increase land value in New England.

234. FREE, G. R., ENGDAHL, E. A., and MCGUINNESS, J. L. Comparative effects of supplemental irrigation and fertility level on yield of a Ladino clover and orchard grass pasture mixture. Agron. Abs. 46:57. 1954. 241 Am39
Pasture irrigation studies at Cornell have been underway since 1947. During 1950-53 on a test plot where the fertility level was high the yield was about 4 tons per acre. Increase from irrigation was very slight with the exception of 1 year when it was nearly 1/2 ton per acre. Irrigation response was higher at lower fertility levels.

235. FREE, G. R., and ENGDAHL, E. A. Irrigation plus good management increases forage yields. Farm Res. [N. Y. Sta.] 19(2):6-7. Apr.1953. 100 N48A
In tests at the New York Soil Conservation Station in 1952 on the effects of irrigation and fertilization on the yield of dry forage, the following results were produced (in pounds per day per acre): Normal fertilization (300 lb. 0-20-20) alone, 27.9; normal fertilization with irrigation, 42. High fertilization (3,000 lb. 0-20-20 plus 8 applications of nitrogen) alone, 55.2; high fertilization with irrigation, 61.6. Mixed fertilization (3,000 lb. 0-20-20) alone, 21.6; mixed fertilization with irrigation, 32.6. The greatest yield resulted from the high fertilization-plus-irrigation combination, but the greatest difference in yield was made when irrigation was added to normal fertilization.

236. FREE, G. R., and ENGDAHL, E. A. Irrigation, supplement, not substitute. What's New Crops & Soils 6(2):12-13. Nov.1953. 6 W55
Research in pasture irrigation at the Arnot Conservation Experiment Station in New York. Normal fertility treatment (300 lb. of 0-20-20 per acre) yielded 14 lb. of dry herbage per acre per day in 1950, 20 in 1951, and 28 in 1952. Irrigation boosted these yields to 19, 27, and 42 lb. High fertility treatment (1,500 to 3,000 lb. of 0-20-20 plus 40 to 50 lb. of nitrogen) yielded 45 lb. per acre per day in 1950, 56 lb. in 1951, and 55 in 1952. Irrigation boosted these yields to 48, 61, and 62 lb. respectively. On 3 occasions in August and September, 1952, yields per cutting for the normal-fertilization irrigated plots exceeded those for the high-fertility plots that were not irrigated.

237. GARMAN, C. G. Our experience with irrigation in 1954. N. Y. State Hort. Soc. Proc. 100:144-149. 1955. 81 N484
Irrigation increased the yield of peaches about 2,000 to 3,000 bu. from 40 acres. The total yield of 12,000 bu. was larger in size so that the increased income was estimated at $4,000 to $5,000 at a cost of about $2,000. This means a net increase in returns of $50 to $75 per acre.

238. GRAY, H. E., LEVINE, G., and KENNEDY, W. K. Use of water by pasture crops. Agr. Engin. 36: 529-531. Aug.1955. 58.8 Ag83
During 1953-54 at Cornell University the consumptive-use-actual-requirements were compared with estimates from the Blaney-Criddle and Thornthwaite methods and the evaporation tank. There was very close agreement between the measured evaporation and the consumptive-use rates. The average daily rate for the 1953 season was .13 in., and was .11 in. in 1954.

239. HALL, J. Farm irrigation for the Northeast. Amer. Agr. 147:460,462-463. Aug.19,1950. 6 Am3
Studies at the University of Massachusetts of 14 irrigated farms in the New England States revealed the following data in part: Total investment ranged from $1,500 to $4,000 per farm, or from $21 to $160 per acre; physical characteristics of the farm had more influence on cost than anything else. On a 100-acre farm with a central water source, the initial cost was only $2,082 and the annual cost was only $11.39 per acre. On a 25-acre farm distant from water, the initial cost was $4,052 and the annual cost was $33.80 per acre. On most farms, a single giant-nozzle sprinkler system, operated at 85 to 120 lb. pressure, was found to be most economical from a labor standpoint, although pumping costs were higher.

240. HAMPTON, R. N., MURPHY, R. G., and HOFF, P. R. Potato irrigation; costs and practices in Suffolk County, New York, 1946. N. Y. (Cornell) Agr. Expt. Sta. B. 862,56 p. Sept.1950. 100 N48C
A study of 23 potato farms in New York in 1946, all of which were irrigated with the rotary-sprinkler or portable-pipe system, revealed the following facts: The cost of irrigating an acre of potatoes was $21.43, or $7.65 per acre-inch, or $.28 per 1,000 gal. of water pumped; fixed costs accounted for 4/5ths of the total, labor for 1/8th, and fuel and power for less than 1/12th; average investment was $81 per acre for small farms irrigating from ponds or shallow wells, $132 per acre for small farms using deep wells, and $109 for large farms pumping from deep wells; overhead costs on the first type of farm were $12 per acre per year, on the second type $19; average cost of labor for all farms was $1.00 per acre-inch; power costs averaged $.58 per acre-inch with diesel or gasoline engines, and $.46 per acre-inch with electric pumps. Plot experiments have shown increases in yields averaging 57 bu. per acre from 1938 to 1945.

241. HARRISON, E. S. Forage crop irrigation in New York. Holstein-Friesian World 52:487-488. Mar.5, 1955. 43.8 H742
Irrigation of forage crops has been profitable in New York, but irrigation of pasturelands has not. At a cost of $2.11 per acre for labor and fuel, 18 acres of hay and corn can be irrigated in one day. Irrigation of hay has produced a second crop of 1 1/2 tons per acre, when unirrigated fields produced no second crop at all. In 1954 one 1 1/2-in. irrigation of corn produced 90 to 100 bu. of shelled corn per acre, when unirrigated fields produced only 25.

242. HEISEY, H. Eight years of orchard irrigation. N. J. State Hort. Soc. Hort. News 35:2802. May 1954. 81 N46
Eight years of irrigation experience with apples near Green Castle, Pa. have shown an average production of over 800 bu. per acre. This is about 15 percent or 100 bu. above the unirrigated orchard. The added income averaged about $400 per acre for a cost of $25.98 for irrigation, $15.00 for additional picking, and $20.00 for the necessary props.

243. HEISEY, J. H. Some results of 8 years' irrigation. Mountaineer Grower 24(201):19. Mar.1954. 80 M86
An applegrower in Greencastle, Pa., has found 1 year out of 8 when irrigation was not needed. One year required only 1 irrigation, 4 years had a definite benefit, and 2 years would have been almost complete failures without irrigation. The system was designed for 150 acres at an investment of only $50 per acre. Operating cost for the average of 2 1/2 irrigations is $25.98 per acre. Production has averaged 800 bu. per acre for an increase of about 100 bu. with irrigation. Quality as well

as yield increase is about $440 per acre at a cost of $25.98 for irrigation, $15 for additional picking, and $20 for propping. Net-income gain is about $379 per acre.

244. HINDMARSH, R. G. Does it pay to irrigate potatoes? East. States Coop. 30(7):22-23. July 1954. 280.28 Ea7
Investment per acre in irrigation equipment for potatoes runs from $100 to $150. On Long Island, studies show that the average investment is $7,000 for a 50-acre field, or $140 per acre. Size of field to be irrigated, as well as location of fields, source and availability of water, influences the investment total. Proper irrigation can result in increases in potato yield up to 60 bu. per acre.

245. HURD, M. Orchard irrigation—1953-54. N. J. State Hort. Soc. Hort. News 36:2868. Feb.1955. 81 N46
An applegrower near Clintondale, N. Y., reports very favorable results in 1953 and 1954. Actual yields are not given but it was estimated that the equipment was paid for in 1953; 1954 was an even drier year so that even better results were obtained. Water rights are a definite problem, on streams in particular. Water should be applied before serious wilting in the heat of the day. Irrigation of peaches paid even better than that of apples.

246. HURD, M. G. A growers' experience with irrigation. Mass. Fruit Growers' Assoc. Rpt. Annu. Mtg. 63:54-60. 1957. 81 M384
An applegrower at Clintondale, N. Y., has added to his irrigation system from 1948 to 1956 so that now he has about $11,000 invested in equipment to irrigate about 120 acres. Cost of developing springs and ponds should be added to this. Irrigation has increased both yield and quality of apples. In 1953 the irrigated orchard yielded 12.9 bu. per tree as compared to 9.16 bu. from the unirrigated. In 1954 the yield was 14.5 from the irrigated and 12.3 from the unirrigated. In 1955 the irrigated yielded 13.8 bu. as compared to 10.4. Frost damage obscured the results in 1956. Even then the unirrigated trees for each of these years received some water from tank trucks. Costs of irrigation are about $26 per acre, of which $10 are overhead costs.

247. HURD, M. G. Our experience with irrigation. N. Y. State Hort. Soc. Proc. 100:204-206. 1955. 81 N484
Investment in equipment to irrigate 82 acres was $7,874. In 1953, apples averaged 12.9 bu. per tree from the irrigated orchard and 9.6 bu. per tree from the unirrigated. In 1954 the irrigated trees averaged 14.5 bu. and the unirrigated 12.3 bu. per tree.

248. JACOB, W. C., and others. The influence of irrigation on the yield and quality of potatoes on Long Island. Amer. Potato J. 29:292-296. Dec.1952. 75.8 P842
M. B. Russell, A. Klute, G. Levine, and R. Grossman, joint authors.
Work at the Long Island Vegetable Research Farm in 1949-51 is described and results summarized. In 1949 the nonirrigated plots produced 258 bu. of U. S. No. 1 potatoes per acre. The biggest increase in yield (to 459 bu.) occurred when the mercury tension of the soil was increased by irrigation to 10 in. This tension also increased the specific gravity of the potatoes from 1.055 to 1.063. In 1950 the nonirrigated plots produced 537 bu. per acre, and the biggest increase (to 574 bu.) occurred when the mercury tension was increased to 40 in. This tension, however, increased the specific gravity of the potatoes only from 1.089 to 1.092. The biggest increase in specific gravity was occasioned by a maximum tension of 5 in. In 1951 the nonirrigated plots yielded 367 bu. per acre, compared to 499 bu. when the maximum tension was 20 in. This tension lowered the specific gravity from 1.083 to 1.082, while a 10-in. tension increased the specific gravity to 1.084. The major points shown are that it is easy to over-irrigate and that optimum moisture levels are about 50 to 60 percent of field capacity of soils.

249. JACOB, W. C. Split-plot half-plaid squares for irrigation experiments. Biometrics 9:157-175. June 1953. 442.8 B5224
Plot designs for irrigation trials are shown as used at the Long Island Vegetable Research Farm. Factors being investigated were potato varieties, irrigation, and nitrogen, phosphorus, and potash fertilizers. Two blocks each 214 by 260 ft. were used and a system of 81 treatments in a 9-by-9 quasi-Latin square was used. More details are given regarding sampling and statistical tests of the results obtained.

250. JANES, B. E. Research on irrigating Connecticut vegetables. Conn. (Storrs) Agr. Expt. Sta. INF-26, 8 p. Apr.1951. 100 C76I
Trials at the Connecticut Vegetable Experimental Farm in 1950, with irrigation of cabbage, corn, and tomatoes, resulted in no increase in yields of corn and tomatoes, although in both cases irrigation increased plant size. With cabbage, however, plants receiving 2.6 in. of supplemental irrigation yielded 18.5 tons per acre, compared to 10 tons per acre for unirrigated cabbage. This is only 1 year's result and the discussion on drought frequency given indicates only 4 years out of 20 without droughts of 25 or more days.

*251. JONES, B. E. Timing irrigation by soil moisture measurements. Conn. Veg. Growers' Assoc. Proc. 43:31-33. 1956. 75.9 C76

252. KERR, H. A., and MARKWARDT, E. D. Irrigation for "high-rainfall" areas. Co. Agent & Vo-Ag Teacher 7(7):18-20. July 1951. 275.28 N213
New York has an average of 30 to 50 in. of rainfall per year, yet irrigation is necessary in most areas during the growing season. Discusses acreage irrigated in the State, sources of water for irrigation, equipment, and costs. The cost of equipment averages about $80 to $100 per acre, exclusive of water supply.

253. KERR, H. A. Irrigation in upstate New York. N. Y. Agr. Col. A. E. 851,68 p. Mar.1953. 281.9 C81
Details are given on where irrigation is being done, types, and sizes of irrigation equipment, and a general picture of farming where irrigation is used. Survey records were taken from 280 farmers in the spring of 1951. Size of acreage irrigated ranged from less than 10 to over 3,000 acres. Information on yields and operating costs was not included in the study.

254. KERR, H. A. A look at irrigation. N. Y. Agr. Col. Farm Econ. 184:4847. Mar.1952. 280.8 C812
Irrigated acreage in New York has doubled each 5-year period since 1935. In 1951 an additional 700 farmers were actively planning installation of irrigation systems.

255. KERR, H. A. Present outlook on New York irrigation. N. Y. State Hort. Soc. Proc. 101:65-69. 1956. 81 N484
In 1910 there were 65 irrigated acres in New York, on 4 farms, 3 of which were on Long Island. In 1944 Long Island had 3,500 irrigated acres, and in 1954, 35,000. One of the chief factors in this increase was the availability of plentiful cheap water from the ground, and the high water table on Long Island. Water needs in the rest of New York State, however, are not so easily satisfied. Adoption of irrigation on a larger scale in upstate New York depends upon the development of water supply, and on a clearer definition of farmers' rights to the use of stream and river water.

256. KOTTKE, M. W., and PUTERBAUGH, H. L. Adoption of supplemental irrigation on Connecticut farms. Conn. (Storrs) Agr. Expt. Sta. B. 336,15 p. Sept.1957. 100 C76S
A general discussion of irrigation in Connecticut showing the trends in adoption of the practice, present status, benefits, sources of water, investment requirements, labor needed, crops irrigated, and information required before venturing into irrigation. It is pointed out that irrigation can be used to prevent drought, for frost protection, and as a means of maximizing profits. Most of the irrigators in Connecticut are using streams or springs as their source of water. The average investment in 1954 was $7,945 per farm or $216 per acre irrigated. Most of the irrigation was on tobacco, vegetables, and potatoes.

257. KUCINSKI, K. J. Irrigation for Massachusetts farms; why, how, when. Mass. U. Agr. Ext. L. 246,31 p. Jan.1956. 275.29 M381L
Includes planning a system, types of equipment, soil moisture, and recommended irrigation practices for

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*Not examined.

vegetable crops, potatoes, strawberries, orchards, cranberries, tobacco, perennial hay, and pasture. Average cost of irrigation equipment, fuel, labor and water is estimated at $5 an acre-inch.

258. LAMB, J. Drought insurance and irrigation. Farm Res. [N. Y. State Sta.] 16:8-9. Jan.1950. 100 N48A
Irrigation has shown some rather remarkable increases in yields of potatoes, tomatoes, snap beans, and beets in New York. Potato yields were increased in Tioga County from 416 bu. to 581 bu. per acre with irrigation. In 1945 beets were irrigated once and the yield was increased from 11.4 to 14 tons per acre. Beets sold that year at $35 per ton.

259. LECOMPTE, S. B. The art of irrigating vegetables. N. J. Agr. 37(4):11-12,16. July/Aug.1955. 275.28 N46
Direct measurements of the drying effect of the air on the crop and of soil-moisture conditions in the root zone were made on yield, quality, and growth speed of sweet corn, broccoli, spinach, peppers, and bunch onions at the Vegetable Research Farm, New Brunswick, N. J., in 1948-55. Measuring devices were an evaporation meter and a direct-current gypsum-block moisture detector. General results given.
Also in Mkt. Growers J. 84(12):6-7. Dec.1955. 6 M34

260. LECOMPTE, S. B. "Hidden eye" tells you when to irrigate. N. J. Farm & Gard. 27(5):20-21,30-31. May 1956. 6 G162
Experiments at the Rutgers Experiment Station since 1948 have developed a soil-moisture meter called the Delmhorst Moisture Detector. It consists of a gypsum-block electrode and connecting cord, and a portable pocket-size direct-current ohmmeter. The blocks are buried anywhere from 6 to 18 in. in the soil, and will work in sand, loam, clay, or muck. The meter costs less than $50, and the plaster blocks and electrode attachments are $.50 each. Use of the device to determine proper timing of irrigation of peppers in 1955 increased yield considerably.

261. LECOMPTE, S. B. Studies measure effects of irrigation on pepper yields. N. J. Agr. 39(5):10-12. Sept./Oct.1957. 275.28 N46
Irrigation was needed for peppers in 3 of the 4 years from 1953 to 1956 at the Vegetable Research Farm at New Brunswick, N. J. Yields were about 11,000 lb. from the irrigated peppers and 1,200 lb. from the unirrigated on a per acre basis. This yield was for the early pickings through Sept. 14. The unirrigated peppers yielded higher late pickings, but the total yield was still nearly 1,000 lb. higher for the irrigated peppers.

262. LELAND, R. A. Grassland irrigation. New England Homestead 123(6):10. Mar.25,1950. 6 N442
Experience on a Vermont dairy farm proved that pasture irrigation can amount to a saving of $2,800 per year in feed costs alone, not considering the increased income from higher milk production. Before irrigation it had cost $54.60 per day to barn feed 70 cows. After installation of a $2,000-sprinkler system, barn-feeding cost dropped to $7.31 per day for 70 cows.

263. LEVINE, G. Engineered irrigation through research. Mkt. Growers J. 82(5):17-19. May 1953. 6 M34
In research conducted at Cornell in 1950 to determine the most economical nozzle size and pressure for sprinklers, it was found that in most soil conditions, the large-nozzle-plus-low-pressure combination was more economical. However, on some soils, the larger drops produced by this combination caused splashing of the soil, with a consequent decrease in infiltration. Experiments on the effect of drop size on infiltration and water retention of the soil are continuing.

264. LEVINE, G., KENNEDY, W. K., and GRAY, H. E. Irrigation of pastures. Agr. Engin. 36:471-473. July 1955. 58.8 Ay83
Experimental results of irrigation and fertilization experiments at Cornell for the years 1953 and 1954. An alfalfa-brome mixture was used in the trials. Irrigation increased yields about 700 lb. of dry matter per acre. Nitrogen fertilizer increased yields by 1,390 lb. per acre, but the 2 treatments were not combined except for 1 cutting the last year.

265. LEVINE, G. Sprinkler effect on soil structure. Amer. Fruit Grower 73(6):15,44. June 1953. 80 G85
Experimental results at Cornell have shown that large drops of water from sprinklers decreased infiltration rates 90 percent on heavy textured soils and 50 percent on light soils. The reduction was 30 percent on both soils when small drops were used.

266. MCALLISTER, D. G. How we water vegetable crops at Seabrook. N. J. Farm & Gard. 25(6):14-17. June 1954. 6 G162
Sprinkler irrigation is used on 2,500 acres of vegetables in New Jersey. Costs are $100 to $150 per acre for equipment, and an estimated $5 to apply an acre-inch of water and to pay off other costs including replacement. Soil conditioners proved too costly to use. Nutrients are not used through irrigation lines.

267. MAGNESS, J. R. Irrigation of orchards in Eastern United States. N. Y. State Hort. Soc. Proc. 100: 197-203. 1955. 81 N484
Experience and weather records indicate that on shallow soils at Poughkeepsie, N. Y., a 20- to 40-percent increase in fruit yield can be expected in 6 of 25 years. On relatively deep soils this response could be expected in 3 of 25 years. Minimum investment in equipment is about $75 per acre and operating costs will be about $25 to $30 per acre per year.

268. MATHER, J. R. An investigation of evaporation from irrigation sprays. Agr. Engin. 31:345-348. July 1950. 58.8 Ag83
Tests at Seabrook, N. J., in 1949 indicate losses from 4 to 30 percent by evaporation from spray of sprinklers. Indications are that water should be applied as rapidly as possible and that the size of the irrigated area should be as large as possible to prevent undue loss from evaporation.

269. MEISTER, R. T. Ontelaunee's happy accident. Amer. Fruit Grower 75(6):12-13,33. June 1955. 80 G85
Ontelaunee Orchards in southeastern Pennsylvania started irrigation of peaches in 1953. Yields of early peaches increased from 1.6 to 3.2 bu. per tree with irrigation in 1954. Size increased from 2 1/4 to 2 1/2 in. In 1954 they irrigated a total of 197 acres, 125 of apples and 72 of peaches, at a cost of $22.10 per acre. A cost breakdown was $6.75 for labor, $.58 for fuel, and $14.77 for depreciation.

270. MESEROLL, W. S. What your neighbors say about irrigation. N. J. Farm & Gard. 24(6):12-13,57-59. June 1953. 6 G162
Personal experiences with sprinkler irrigation on 6 New Jersey farms: Successful results with irrigating 50 acres of Ladino-brome for 50 cows with a system that cost $9,000; irrigating 70 acres of corn and broccoli at a cost of about $5 to $6 an acre per watering, using a giant sprinkler head to reduce labor; a $10,000 system used to irrigate 80 acres of lettuce paid for itself in 1 year; 5 irrigations of a 20-acre pickle plot cost $20 per acre in operating expenses; irrigation increased tomato yields 5-fold; irrigated potatoes in 1952 yielded about 250 100-lb. bags per acre with an increase in No. 1 potatoes; young blueberry plants developed faster and with no plant loss when irrigated.

271. MILLIMAN, T. E. Effects of irrigation on potato yields. G. L. F. Week 16(48):1. May 26,1952. 280.28 G113W
In 1951 rainfall in New Jersey was plentiful enough to convince most potato growers that supplementary irrigation was unnecessary for that season. However, a farmer applied 3 applications of water to 60 acres, leaving 30 acres unirrigated except for rainfall. His yield on the irrigated acres was 601 bu. per acre, while on the unirrigated 30 acres the yield was 493 bu. per acre, bringing him a sizable net profit over that of his nonirrigating neighbors.

272. MITCHELTREE, W. A. Water, tilth and rootage. Farm Impl. News 76(16):50,52. Aug.25,1955. 58.8 F22
Available soil-moisture-holding capacities are given for several New Jersey soils. One foot of soil varies in its capacity from 1.2 to 2.3 in. of moisture depending on

texture. Depth of rooting is about 48 in. for tomatoes; 30 to 36 in. for sweet corn; wheat, and potatoes about 21 in.; spinach about 12 in.; and asparagus about 48 in.

273. PALMER, R. S. When do we need to irrigate? N. H. Agr. Ext. Sta. Prog. Rpt. 3(3):12-14. June 1957. 100 N452
Records of 15 weather stations in the New England States have been analyzed for the period from 1926 to 1955. A graphic presentation of this data is given for estimating seasonal water needs. In New Hampshire a forage crop growing on a sandy loam soil with an available moisture capacity of 2 in. can expect moisture deficiency at least 24 days each year in 4 out of 5 years. A deficiency can be expected for at least 60 days in 1 out of 5 years, and for 69 days in 1 out of 10 years.

274. PECK, N. H. Irrigation made the difference. Farm Res. [N. Y. Sta.] 22(2):6. Apr.1956. 100 N48A
Rate of growth and yields of sweet corn for 1955 were reported for Geneva, N. Y. The irrigated corn grew about 22 in. higher than the unirrigated which was nearly 56 in. high. Yields were 4.4 tons from the unirrigated and 5.7 tons of unhusked corn per acre from the irrigated plot.

275. PECK, N. H. Measuring irrigation needs. Farm Res. [N. Y. Sta.] 22:9. Jan.1956. 100 N48A
Experiments with varieties of peas, alfalfa, tomatoes, cabbage, and sweet corn at the Agricultural Experiment Station, Geneva, 1952-55, using 300 to 360 gypsum blocks covering 12 acres, employing combinations of nonirrigated versus irrigated, high versus normal fertility levels, and various spacings of crops.

276. PEIKERT, F. W. Added profits from irrigation. N. J. State Hort. Soc. Hort. News 32:2385,2387,2398,2400. May 1951. 81 N46
In 1949 irrigated sweet corn produced 1,297 doz. marketable ears per acre as compared to 363 without irrigation. Snap beans increased 41 percent with irrigation and tomatoes increased from 472 to 770 bu. per acre when irrigated. General costs and uses of sprinkler irrigation for fruits, berries, and vegetables are given.

277. PEIKERT, F. W. Plan carefully before you irrigate. N. H. Hort. Soc. J. 16:59-63. 1953. 81 N452J
Investment in sprinkler-irrigation equipment generally averages about $100 to $150 per acre for a system capable of irrigating 30 acres. Operating costs will generally be about $20 to $30 per acre per year. Potatoes, vegetables, berries, and sometimes pasture and tree fruits are most commonly irrigated in New Hampshire.

278. PEIKERT, F. W. Rainfall plus irrigation for highest returns per acre. Mkt. Growers J. 83(4):12-13, 46. Apr.1954. 6 M34
Estimated costs for irrigating 30 acres or more are $100 to $125 per acre for equipment; annual costs covering interest, depreciation of equipment, labor, and power usually average $22 to $30 per season. Tests on sweet corn at the University of Maine in 1950 indicated that irrigation hastened maturity and increased the yield to 2.99 tons per acre as compared with 2.02 tons per acre of unirrigated corn. Net value of increase per acre from irrigation of Erie ranged from $44.18 to $162.90. For Golden Cross Bantam, net value of increase per acre from irrigation was from $52.18 to $263.90.

279. PORTABLE sprinkler irrigation. Fortune 41(6): 97-98,132,134. June 1950. 110 F772
Sprinkler irrigation is spreading rapidly in all parts of the United States. The East has over 500,000 acres under sprinklers. A Long Island potato grower reports potato yields increased about 50 percent. Investment costs generally run from $50 to $200 per acre.

280. PRATT, A. J. Irrigating potatoes in the Northeast. Mkt. Growers' J. 85(3):6-8. Mar.1956. 6 M34
Irrigation experiments at Cornell have shown that the time of irrigation is as important as the irrigation itself. Over a period of two years, potatoes irrigated when the available soil moisture had dropped to 50 percent yielded 713 bu. per acre; when soil moisture had dropped to 25 percent, the yield was 613 bu.; and when the moisture had dropped to only 5 percent before irrigation was started, the yield was only 581 bu., compared to a yield of 525 bu. per acre on completely unirrigated soil.

281. PRATT, A. J. Irrigation—a form of crop insurance. Farm Res. [N. Y. State Sta.] 18(2):8-9. Apr. 1952. 100 N48A
Tests conducted by the Cornell Department of Vegetable Crops in 12 counties of New York over a 3-year period, on the effects of irrigation on potatoes, showed the following increase in yield of marketable potatoes after irrigation: 1949 - 18.4 percent; 1950 - 17.5 percent; 1951 - 9.4 percent. The effect of irrigation on total tuber set of potatoes irrigated only after the potatoes had reached the blossom stage was: 1949 - 16.3 percent increase; 1950- 6.5 percent; 1951 - 7.8 percent.

282. PRATT, A. J. Irrigation to make a crop in the humid East. Mkt. Growers J. 84(5):6,27. May 1955. 6 M34
Gives results of experiments conducted by Cornell University. Onions irrigated when the available soil moisture had reached 50 percent yielded 913 bu. per acre, compared to a yield of 520 bu. per acre when unirrigated. Potatoes yielded 682 bu. per acre with the same irrigation, and 474 bu. with no irrigation. Experiments on corn, peas, lima beans, and tomatoes, with the effect of 1 1/2 in. of sawdust mulch plus irrigation, gave the following results: Yield of peas increased 46 percent with mulch alone, 40 percent with irrigation alone, and 86 percent with both; corn increased 40 percent with mulch, 54 percent with irrigation, and 89 percent with both; lima beans increased 20 percent with mulch, 30 percent with irrigation, and 20 percent with both; tomatoes increased 64 percent with mulch, 90 percent with irrigation, and 141 percent with both.

283. PRATT, A. J. Northeastern potato growers irrigate. Mkt. Growers J. 81(5):18-19. May 1952. 6 M34
Irrigation trials in New York in cooperation with 4-H Club members in several counties in 1949 to 1951 gave very favorable yield increases. 1951 was a wet season but still yields varied from an increase of 145 bu. to a loss of 28 bu. with irrigation. In 1949 in 5 counties, 510 plots were irrigated and 416 were not. The average yield increase was 94 bu. per acre. In 1950 in 4 counties 456 plots were irrigated and 376 were not, for an average increase of 80 bu. In 1951 in 6 counties the average increase was 38 bu. on 392 plots irrigated and 354 plots not irrigated.

284. PULLEN, W. E., and SCHRUMPF, W. E. Irrigation can pay off! Maine Farm Res. 5(2):15-17. July 1957. 100 M28Ma
Cost per acre per year for irrigating potatoes in Maine is about $40. The range of costs is from $66 to $20 per acre. Fixed costs comprise about 64 percent of the total annual cost. If the price of potatoes is $1.00 per bu. an increase of 40 bu. is needed to cover these added costs, not including additional harvesting costs. Fourteen farms in 1955 averaged an additional yield of 90 bu. per acre.

285. RECK, S. H. Will irrigation pay on your farm? N. J. Farm & Gard. 21(4):18-19. Apr.1950. 6 G162
A New Jersey potato farmer, on irrigated land under continuous cultivation, increased his yield from 175 bu. to 333 bu. per acre after 9 irrigations. On land in a 2-year rotation, irrigation increased yield from 192 to 407 bu. per acre. A dairy farmer in the same State got 4 cuttings of alfalfa in a drought year after irrigation, harvesting 6 tons per acre. Pasture irrigation produced a 33-percent increase in feed on the same dairy farm.

286. SARGENT, M. Pasture irrigation. New Eng. Homestead 124(2):3,6. Jan.27,1951. 6 N442
A dairy farmer in New Hampshire was able to graze his entire herd on his own pasture after he had irrigated, whereas before irrigation he had had to rent extra pasture during the grazing season. In Vermont a dairy farmer has irrigated 17 acres of pasture at a cost of $2.22 per acre-inch. In addition to other benefits, he has found that irrigated pasture requires reseeding only every 10 years, compared to every 3 or 4 years with unirrigated pasture.

287. SHAW, H. R., and CROSSMAN, B. D. Irrigation possibilities on Massachusetts dairy farms. (Abs.) New England Res. News 19:23. Feb.1951. 281.9 N44
Abstract of thesis (M.S.) - Massachusetts University, 1951.

A comprehensive report of research on the economics of irrigation on dairy farms. Some of the facts revealed were: Investment in sprinkler systems for the typical dairy farm is between $90 and $100 per acre; when all costs are included, and 1-ton average annual additional yield is obtained from 6 in. of water, the total cost is about $29 per ton for the additional yield; the average annual increase in yield of hay due to irrigation will not exceed 1.25 tons per acre.

288. SMITH, E. J., and JOHNSTONE, W. F. Irrigation; 20 questions and answers. Pa. State Col. Agr. Ext. Spec. C. 10,10 p. June 1953. 275.29 P382Sp

The initial cost of an irrigation system may vary from $1,500 to $15,000, with an average cost of $5,560. Operating costs may vary from $1.12 to $14 per acre-inch, with an average cost of $4.02. When annual fixed costs are added to operating costs, the average is $13.40 per acre-inch, ranging from a low of $2.74 on one farm to a high of $51 per acre-inch on another. Of 48 farmers questioned as to benefits received from irrigation, 2 reported no increase in yield, 8 reported an increase up to 20 percent, 24 reported an increase up to 40 percent, 10 reported up to 60 percent, 1 reported up to 80 percent, and 3 farmers reported an increase in yield as high as 100 percent. Labor requirements averaged about 4 hours per acre per irrigation in 1949. The range was from less than 2 hours to over 10 hours per irrigation.

Also in N. H. Agr. Col. Ext. C. 306,10 p. June 1953. 275.29 N45C

289. SPRAGUE, D. C. Supplemental irrigation in the Northeast. (Abs.) J. Dairy Sci. 36:605. June 1953. 44.8 J822

Primarily pasture irrigation. States that when management problems are solved, and where there is an adequate water supply, pasture irrigation in the Northeast will become a common practice. Costs vary greatly, the largest single item being that necessary to amortize the initial investment. This is affected by the proximity of water, the amount of use made of the system, and the equipment selected.

290. STANTON, B. F., and STEVENS, D. M. Costs and returns in producing tomatoes for processing, 123 farms, western New York, 1955. Cornell U. Col. Agr. A. E. 1025,34 p. Mar.1956. 281.9 C81

Irrigation, p. 27-28. Fourteen of 78 tomato growers in western New York used irrigation in 1955. Investment costs per farm ranged from $2,000 to $10,500. Costs of applying an acre-inch of water exclusive of labor ranged from $3 to over $11 and averaged $5.89. Yields per acre increased from 9.5 to 13.7 tons. Other growing costs such as fertilizer and labor increased from $156 to $199 per acre when irrigation was applied at an average rate of 2.7 in. per acre. Net returns averaged $89 with irrigation and $41 without, on an acre basis. Total returns were an average of $404 per acre with irrigation and $312 without irrigation.

291. STANTON, B. F. Operating costs for irrigation equipment, western New York, 1956. N. Y. State Col. Agr. (Cornell U.) Dept. Agr. Econ. A. E. 1061,22 p. May 1957. 281.9 C81

Between 1900 and 1954 acreage under irrigation in New York increased from 123 to 59,024. Of this latter total, 30,996 acres were in field crops (principally potatoes), 22,412 were in vegetables, 3,514 were in fruits, and the remainder were in nursery and flower crops. In 1956 a study was undertaken by the State College of Agriculture to provide some basic data on the cost of operating sprinkler systems. For the study, 81 upstate farms were chosen at random. Of this number the majority, 32 farms, had an original investment of between $2,500 and $5,000 in sprinkler equipment. The next largest group, 21 farms, had an original investment of between $5,000 and $10,000. Seventeen farms had an investment of between $1,000 and $2,500; and the smallest group, 11 farms, had an original investment of over $10,000. Average annual operating costs, including fixed costs, ran from a minimum of $462 for the farms having the least expensive equipment, to $2,162 for the 11 farms with the most expensive equipment. Average operating costs per acre irrigated were $30.80 for the $1,000-$2,500 group, $31.86 for the $2,500-$5,000 group, $28.76 for the $5,000-$10,000 group, and $43.24 for the over $10,000 group. Average operating costs per acre-inch applied were $9.43, $9.74, $14.65, and $19.83, in the same order.

292. STARR, J. T. Irrigation is crop insurance. Rur. New Yorker 107(5884):306,311. May 18,1957. 6 R88

Irrigation is generally required in New York about 3 times in 2 years as shown by weather records of periods of 10- to 14-days duration without rain. Most of the irrigation in New York is on high-value vegetable crops.

293. STRATTON, C. L. Are you going to irrigate? New Eng. Homestead 126(7):22-23,26. Apr.11,1953. 6 N442

Experiences of several New England farmers in developing water supplies are related. Sites for irrigation ponds should be tested before the pond is dug for recharge rates. A celery grower and other market growers relate that they would be out of business except for irrigation. Dairymen and fruitgrowers have also found that irrigation is essential for their operations.

294. STRUCHTEMEYER, R. A. Operation rainfall plus. Maine Farm Res. Apr.1953:7-9. 100 M28Ma

Experiments at the Maine Agricultural Experiment Station with supplemental irrigation of potatoes, corn, beans, blueberries, and pastures, from 1946 to 1952, showed an increase in yield as well as in quality of all crops. Increase in yield of potatoes varied from a low of 29 bu. per acre in one year to a high of 115 bu. per acre in the best year. Blueberry yields went from zero on an unirrigated plot in a dry year, to a yield of 50 bu. per acre on an irrigated plot in the same year. Sweet-corn yields were 10,000 lb. per acre higher on an irrigated plot than on an unirrigated plot.

295. TALMAGE, H. Irrigation on Long Island. In Johns-Manville Corporation. Supplemental irrigation, p. N. Y. 1-2. New York,1951. 55 J62

General discussion of results of irrigation of vegetables from 1937 to 1945. The 8 years prior to 1937, when irrigation systems were installed, are compared to the 8 years since 1937. The average annual yield of cauliflower increased 83 percent with irrigation after 1937, and the average annual yield of potatoes increased by 65 percent.

296. THORNTHWAITE, C. W. Climate and scientific irrigation in New Jersey. Seabrook,N. J.,1953. 8 p. (Johns Hopkins University. Laboratory of Climatology. Publications in Climatology, V. 6, No. 1) 341 T39

Maximum crop production will be obtained when defects in climate are remedied wherever possible. Scientific scheduling of water when it is not provided by nature is required for maximum yields. A climatological approach in determining when and how much irrigation water to apply is meeting increased success. This method uses evapotranspiration rates and a bookkeeping procedure in which the available-moisture-holding capacity of the soil root zone is the balance. Additions are in the form of rainfall or irrigation. The disposal of industrial-waste water from Seabrook Farms in a sandy area has shown that even this so-called waste land is very productive if handled properly. Southern New Jersey has large areas of this potentially productive land.

297. TOBACCO irrigation experiments during fifteen years. In Johns-Manville Corporation. Supplemental irrigation, p. Conn. 3-5. New York,1951. 55 J62

Of the 15 years, 1930-45, 7 were drought years in the Connecticut tobacco-growing region. In the 7 drought years of 1930, 1934, 1936, 1940, 1941, 1943, and 1944, experiments were conducted at Windsor, Conn., on the value of irrigating tobacco crops. It was found that irrigation without added nitrate tended to leach out the nitrogen from the soil. The average results for the 7-year experiment were as follows: Check plot (no irrigation, no nitrate), 1,716 lb. per acre; irrigated, nonnitrated plot, 1,732 lb. per acre; irrigated, nitrated plot, 1,966 lb. per acre. The relative crop value of the tobacco from the check plot was $100; $98.30 for the irrigated, nonnitrated plot, and $137.60 for the irrigated, nitrated plot.

298. VITTUM, M. T. Canning crops respond to irrigation in New York tests. Canning Trade 75(30):64-65. Feb.9,1953. 286.83 T67

Evapotranspiration data, calculated according to Thornthwaite's formula for northern New York, indicate a crop requirement of 15.2 in. of water during the 3 summer months. Weather records show that in 28 years out of a hundred rainfall during these 3 months averages less than 7 in., and in 80 years out of a hundred it averages less than 11 in. So supplemental irrigation is necessary in northern New York 4 years out of 5. In tests at the State Agricultural Experiment Station at Geneva, 1948-52, supplemental water to the level of 15.2 in. including rain fall, was applied to snap beans, tomatoes, peas, sweet corn, and cabbage. In 1948 irrigation increased tomato yield by 5.39 tons per acre, and reduced blossom-end rot. In 1949, irrigation increased tomato yield by 4.46 tons per acre, increased the average weight of the fruit by .05 lb., increased the number of fruit per plant by .6, reduced the number of fruit with blossom-end rot by 10.4 percent, and reduced the average grade of U. S. No. 1 from 75.6 to 73.2 percent. In 1952 irrigation increased yield of Perfection peas by 80 lb. per acre, and sweet corn by .87 tons per acre. It decreased tomato yield from 14.8 to 12.2 tons per acre, owing to the rapid growth of a rye-grass cover crop seeded following the last cultivation. Grass was so high at tomato harvesttime, that the pickers could not find the fruit.

299. VITTUM, M. T. Irrigation experiments with canning crops. Farm Res. [N. Y. State Sta.] 16(2):6. Apr.1950. 100 N48A

In western New York in 1948 snap beans increased yields from 4,220 lb. per acre to 5,890 lb. when irrigated. Tomatoes increased the same year from 14.2 tons per acre to 19.5 tons with irrigation. In 1949 the yield increase with 2 varieties averaged 10.3 tons without irrigation and 15.5 tons with irrigation. The unirrigated tomatoes were higher in acid than the irrigated, and blossom-end rot was reduced when irrigated. Maturity was delayed and coloring was poorer on the irrigated tomatoes.

Also in Canning Trade 72(43):7. May 15,1950. 286.83 T67

300. VITTUM, M. T., and PECK, N. Proper spacing and irrigation can improve your cabbage. Farm Res. 20(2):16. Apr.1954. 100 N48A

Experiments conducted at the New York Agricultural Experiment Station at Geneva with the effects of irrigation and spacing on the yield and quality of cabbage, resulted in the following findings: The smallest yield in tons per acre (23) occurred when plants were placed 36 in. apart and were not irrigated; the largest yield (35 tons per acre) occurred when plants were 12 in. apart and were irrigated. Irrigation increased yield in the 36-in. spacing by 11.5 percent, in the 24-in. by 13.3 percent, in the 18-in. by 14.7 percent, and in the 12-in. by 14.3 percent. The largest heads of cabbage (11.1 lb.) were produced when spaced at 36 in. and irrigated; the smallest heads (4.8 lb.) were produced when spaced at 12 in. and not irrigated. Irrigation increased the head weight in the 36-in., 24-in., 18-in.. and 12-in. spacings by 10.2 percent, 17.1 percent, 18.4 percent, and 20 percent respectively. However, the percentage of burst or split heads was higher for all spacings in the irrigated plots than in the unirrigated: 2.6 percent higher at 36 in., 1.9 percent at 24 in., 3.6 percent at 18 in., and 2.1 percent at 12 in.

301. WALLACE, J. M. We irrigate too fast—and too late! N. J. Farm & Gard. 28(4):18-22. Apr.1957. 6 G162

Experiences at the Seabrook Farm in New Jersey show that rain is never sufficient, even in wet years, for fullest development of a crop, and that most farmers irrigate too little and too late. At Seabrook the soil at the roots is never allowed to dry out. As an experiment, a field of snap beans was divided into 2 parts, 1 to receive "normal" irrigation at the rate recommended by irrigators and used by most farms, and the other to receive maximum irrigation. The first plot was allowed to fall to 30 percent of moisture capacity before irrigation was applied. The second plot was never allowed to fall below 60 percent. The result was that the beans on the second plot were of much superior quality and heavier yield, realizing $45 per acre more in the market than the beans from the normally irrigated crop. With a sprinkler system costing $150 per acre, the annual cost for the average 8-year amortization period would come to $18.65 per acre. Operating costs average $5 per acre. The life of the pump averages 15 years, and that of the pipes 10 years, leaving 2 to 7 years in which the fixed costs drop below the operating costs.

302. WILLITS, N. A. Pasture irrigation — New Jersey. What's New Crops & Soils 5(6):20. Mar.1953. 6 W55

A New Jersey dairy farmer, over a 3-year period, irrigated pasture at an average cost of $31 per acre per year for four 1-in. applications. The average forage-yield increase was only 7 percent per year, and in the best year, 1949, the increased yield was barely enough to pay for the fuel and labor expended on irrigation. However, the milk production was increased.

303. WOODING, N. H. Planned irrigation pays. Pa. State U. Ext. Spec. C. 33,6 p.-folder. May 1957. 275.29 P382Sp

A general guide showing the considerations necessary for irrigation in Pennsylvania. Emphasis is placed on needed water supply, water rights, soil considerations, selecting equipment, and crops to be irrigated. Generally the yield response will justify the expense on small fruits, vegetables, orchards, and some field crops. Irrigation of forage crops requires careful analysis for each individual situation for economic feasibility.

304. WOODING, N. H., and MYERS, E. A. Supplemental irrigation with sprinklers. Pa. State Col. Agr. Ext. Spec. C. 8,23 p. Apr.1953. 275.29 P382Sp

Primarily instructions for the installation of sprinkler irrigation. Tells how to estimate costs. Fixed costs cover interest on investment, taxes, depreciation, insurance, and dam or pond maintenance. These costs are incurred every year whether the system is operated or not. Operating costs include fuels, lubricants, repairs, and labor costs. The repair costs of a gasoline engine are about 10 percent of the annual fuel cost, and those of a diesel are about 25 percent. It requires 1 man-hour of labor per acre for each application to move the laterals, and 1 out of 20 man-hours to service the power unit. Primary considerations are water supply, legal requirements of water use, soil characteristics, kind of crops grown, and land elevation. The advantages of sprinkler irrigation are increased yields, higher crop quality, use for application of soluble fertilizers, use for frost-damage prevention, and applicability to all types of land without prior preparation.

305. WORK, P. Ag leaders will find irrigation is widespread. Better Farming Methods 23(6):36-37. June 1951. 58.8 B46

Sprinkler irrigation is widely used in vegetables on Long Island, and increases yields, improves quality, and hastens maturity of the crops. Costs are from $5 to $7.65 per acre-inch.

306. ZEIGER, D. C. A study of the response of mature Stayman and Rome Beauty apple trees to irrigation and fertilizers. Diss. Abs. 16:1771-1772. Oct.1956. 241.8 M58

Abstract of dissertation (Ph.D.) Rutgers University, 1956.

Effects of fertilizer, trace elements, and trace elements added to fertilizer at two levels of irrigation and no irrigation on fruit abscission, disease, yields, and size of fruit.

NORTH CENTRAL STATES

307. ALBRECHT, R. Pasture irrigation in the Corn Belt. Prairie Farmer, Gen. Ed. 122(18):1,50. Sept.16, 1950. 6 P883

At the Dixon Springs Experiment Station, Robbs, Ill., a 5-acre pasture was irrigated 3 1/2 times for a cost of $37.50 per acre. Increased returns were $30.53, but where additional lime, superphosphate and potassium were provided the returns were $46.12 or a profit of $8.32 per acre. These irrigation costs are high, as this system could easily have cared for about 4 times as many acres. On larger systems average costs are about $20 per acre. Irrigation is compared to enlarging the farm as a means of increasing income.

308. ALLRED, E. R., and CHEN, R. Evaluating irrigation needs in humid areas. Agr. Engin. 34:611-615, 619. Ref. Sept.1953. 58.8 Ag83

Irrigation needs for Minnesota are shown using rainfall, soil-available-moisture-holding capacities, and the evapotranspiration rates of alfalfa, corn, and grain. The method of computing and using weather records on IBM punchcards is explained in considerable detail. At Minneapolis for a 62-year period irrigation was not needed for alfalfa, corn, and small grains during 16, 23 and 56 percent of the years, respectively.

309. BANTA, E. S. How to choose an irrigation system. Amer. Veg. Grower 2(6):7,22. June 1954. 80 C733
The choice of the system depends upon the type of soil, the source of water, the land drainage, and the crop to be grown. An Ohio farmer installed an electric-pump system operating from a 100-ft. well, at a cost of $2,700. At an annual cost of $5.50 per acre-inch ($4.00 depreciation, $1 for fuel, and $.50 for labor) with seven 1-in. irrigations, he boosted his potato yield from 250 to 500 bu. per acre.

310. BANTA, E. S. Irrigate for frost control. Amer. Veg. Grower 4(4):42-43. Apr.1956. 80 C733
Sprinkling has proved more effective and less expensive than heaters or wind machines in preventing frost damage to strawberries in Michigan. Irrigation should be started when the temperature drops to 34° F., and should continue throughout the period of below-freezing temperature. Water should be applied at the rate of 1/8 to 1/4 in. per acre per hour — enough to wet the leaves but not to soak the soil. With this treatment strawberry blossoms have been successfully pulled through temperatures as low as 20° F.

311. BARLOWE, R. Problems in the economics of supplemental irrigation in humid areas. Mich. Agr. Expt. Sta. Ag. Econ. 529,22 p. May 1953. 275.29 M581
Most farmers in humid areas make the mistake of regarding supplemental irrigation as insurance against drought in very dry years, rather than as a regular practice to be used in all but unusually wet years. Experience has shown that at least with high-value crops, irrigation in nondrought years improves quality and increases yield. It has been shown that a system to irrigate 5 to 15 acres can be bought for $1,000 in cases where the water source is on the surface and is adjacent to the field to be irrigated. Under such conditions a system to irrigate 15 to 30 acres can be bought for $2,400, and one to irrigate 30 to 50 acres can be had for $4,400. Where pumps and deep wells are required, these costs would rise to $3,350, $5,150, and $6,550,respectively. Also discusses operating and carrying costs of various sizes and types of systems, and uses of irrigation equipment on secondary crops.

312. BEASLEY, R. P. Irrigation methods and costs. Plant Food J. 8(4):4-5,17-18. Oct./Dec.1954. 57.8 P692
Sprinkler-system costs vary from initial cost of $40 to $200 per acre; land leveling for surface irrigation may range from $25 to $50 per acre; fixed costs are approximately 11 percent of initial costs; operating costs vary with each system. A field survey was made of irrigation systems in south Missouri in 1953. Information on costs on 24 returns disclosed that many irrigators of less than 50 acres were not using their equipment to capacity and as a result their investment per acre was relatively high. Those who irrigated over 50 acres had an equipment investment of $56 per acre and were making full use of their equipment. The same applied to annual costs per acre-inch of water applied. Farmers who irrigated pastures and applied over 500 acre-inches of water made full use of their systems at an annual cost of $1.62 per acre-inch.

313. BEASLEY, R. P. Selection and design of irrigation systems. Mo. Agr. Expt. Sta. B. 629,20 p. Aug. 1954. 100 M693
Includes costs, excluding water supply. The initial cost of equipment in Missouri in 1953 was $197 per acre for 10 acres, $165 for 25 acres, $107 for 44 acres, and $56 for 90 acres. The annual cost of 1 acre-inch of corn irrigation, including fixed costs, labor, and fuel, was $5.69 for less than 100 acres and $4.16 for more than 100 acres. The annual cost of irrigating pastures and forage crops was $5.30 per acre-inch on fields less than 100 acres, $3.64 for fields 101 to 300 acres, $1.90 for fields 301 to 500 acres, and $1.52 for fields 501 to 1,000 acres.

314. BEAUCHAMP, K. H. Irrigation guide for North Central States. Agr. Engin. 36:31-34,37. Jan.1955. 58.8 Ag83
Describes the principles involved in developing irrigation guides for the use of technicians in the Soil Conservation Service, the extension service, and in colleges. Guides have been prepared for Ohio, Michigan, Illinois, and Indiana. Sprinkler irrigation is the only method considered. These guides are designed to give standards-of-use rates of different crops, factors involved with different soils, and details of amounts to apply and when to irrigate.

315. BILANSKI, W., DAVIS, J. R., and KIDDER, E. H. Frost protection by sprinkler irrigation; a field survey Mich. Agr. Expt. Sta. Q. B. 36:357-363. May 1954. 100 M58S
Findings are reported from personal interviews with 34 farmers in different parts of Michigan who use irrigation for frost control. Median temperature to start irrigating was about 34° F. The opinion of about 80 percent of the growers on damage to unirrigated areas was that unprotected areas suffered about 100-percent loss. Nearly half the growers estimated that the irrigation system paid for itself in 1 year; the remainder varied from 2 years to a belief that, used as frost control alone, the system would not pay for itself.

316. BITTINGER, M. W., and FREVERT, R. K. Irrigation in Iowa? Iowa Farm Sci. 6(11):178-180. May 1952. 275.28 Io94
Every year, of 20 studied, Iowa suffered at least 13 days without any rainfall during the summer months. The answer may be supplemental irrigation, but records would need to be kept for the next 10 to 20 years before any definite conclusions can be drawn about the economy of irrigation. Figures so far compiled by the Iowa Agricultural Experiment Station indicate that a farmer would have to increase his income an average of $20 per acre each year over a period of years to break even on supplemental irrigation in Iowa.

317. BITTINGER, M. W., and FREVERT, R. K. Labor requirements for sprinkler irrigation of corn. Agr. Engin. 33:271-272. May 1952. 58.8 Ag83
Time trials of moving pipe and sprinkler risers were compared at Iowa State College in tall corn in 1950 and 1951. Size of pipe made little or no difference in time of moving. Generally it requires about .8 to 1 man-hour per acre per irrigation. Using forked sticks to hold the pipes above the corn required a slightly longer time than holding the pipe overhead by hand. As sprinkler size and spacing are increased, the amount of labor goes down because of fewer moves needed to irrigate the field.

318. BLACK, R. D. Growing use of water for irrigation in Illinois. Amer. Water Works Assoc. J. 49(5): 537-540. May 1957. 292.9 Am32J
In 1951 there were 9,000 irrigated acres in Illinois, with a total pumping capacity of 25,000 gal. per minute. In 1957 an estimated 16,000 acres were being irrigated, with an estimated pumpage of 75,000 gal. per minute. As the use of irrigation spreads, all sources of water will be tapped, and eventually the State legislature will have to recognize the problem and provide laws to govern water distribution. Under present law, percolating waters are the property of the landowner. This means that the farmer with the largest pump may render his neighbors' wells useless.

319. BREGGER, J. T. Survey of recent fruit tree irrigation studies. Hoosier Hort. 34:83-86. July/Aug. 1952. 81 In2H
"Benefits from irrigation in humid areas have been outstanding for tree and small fruits." A Missouri orchardist doubled the tonnage of apples in an 80-acre orchard with only 1 irrigation of 1 1/2 in. of water. A New York grower increased the size of his apples by 1/3, with 200,000 gal. water applied once to a 2-acre orchard. The Ohio Experiment Station reports a yield of 5,560 qt. of strawberries with irrigation, vs. 2,640 qt. yielded on the same plot in another year without irrigation. The advantages of sprinkler over furrow irrigation include: 1, Improved results from fertilizers; 2, less water usage; 3, no land grading required; 4, a reduction in labor amounting to 50 percent; 5, less skilled labor required; and 6, a more uniform distribution of water.

320. BROUGHTON, A. Make rain while sun shines; irrigation takes a little more 'gamble' out of farming. Wis. Agr. & Farmer 77(13):6. July 1,1950. 6 W751

At a cost of $1.25 per acre-inch, a Wisconsin farmer increased his potato production from a preirrigation normal of from 60 to 140 bu. per acre, to an average of 225 bu. per acre the first year of irrigation, and to 300 bu. per acre the second year.

321. BUSHNELL, J. First-year results of an irrigation experiment with early potatoes. Ohio Veg. & Potato Growers Assoc. Annu. Proc. 35:124-129. 1950. 75.9 Oh3

An experiment conducted at the Ohio Truck Crops Experiment Farm in 1949 is described, and results summarized. Total yield of potatoes, with no irrigation, was 384 bu. per acre, of which 70.7 percent were No. 1 grade, and 9.4 percent were culls. Five irrigations yielded 420.8 bu. per acre, of which 74.4 percent were No. 1 grade and 6.1 percent were culls. Nine irrigations yielded 440.8 bu., of which 77.1 percent were No. 1 grade and 6.6 percent were culls.

322. CANNON, G. Irrigation will pay off in the Midwest. Farm Q. 9:44-49,108,110-112,114-118. Spring 1954. 6 F22995

Discusses many aspects of irrigation, including water supply, planning the system, operation of the system, and costs and returns. An Indiana farmer reported a net profit of $93 per acre from his irrigated corn after deducting the costs of operation and interest and depreciation of the system.

323. CAROLUS, R. L., and SCHLEUSENER, P. E. Effect of irrigation on the yield of snap beans, sweet corn and tomatoes as influenced by certain cultural practices in 1949. Mich. Agr. Expt. Sta. Q. B. 32:465-478. May 1950. 100 M58S

Investigations at the Michigan Agricultural Experiment Station in 1949 showed that snap beans were not much affected by irrigation alone, as the available moisture was sufficient throughout the growing season. However, increased irrigation combined with increased fertilization resulted in a yield increase of 1.14 tons per acre. Corn yield was affected by less than 10 percent by irrigation with normal fertilization, but when fertilizer application was increased from 500 to 1,000 lb. per acre, the yield of corn increased by 1.31 tons per acre. Irrigation of tomatoes under normal fertilization increased yield by only .33 tons per acre, but when fertilization was heavy, yield increased by 3.8 tons per acre more than the lightly fertilized and irrigated, or by 4.13 tons per acre over the lightly fertilized and unirrigated.

Also in Food Packer 31(11):33,57; (12):46-48. Oct.-Nov. 1950. 286.83 C165

324. CATE, H. A. Can pasture irrigation increase animal gains by a thousand pounds more beef per acre? Co. Agent & Vo-Ag Teacher 9(5):20-22. May 1953. 275.28 N213

Research on pasture irrigation at the Dixon Springs Experiment Station in southern Illinois.

325. CHISHOLM, J. A. Michigan canner shows growers the way. Mkt. Growers J. 81(5):20. May 1952. 6 M34

Irrigation enabled a Michigan canner to reduce the number of growers supplying the cannery from 1,700 to 60. Yields were increased from 1,400 lb. per acre to 6,000 lb. The average grower now has 20 acres, and over 90 percent of the acreage is irrigated.

326. CLUPPER, H. Some observations on the problems of irrigation with strawberries, black raspberries, and apples; the last stage of crop perfection. Mich. State Hort. Soc. Annu. Rpt. 83:82-87. 1953,pub.1954. 81 M58

A Michigan fruitgrower describes his experience with irrigating 60 acres of apples, 20 acres of strawberries, and 10 acres of black rasperries, by sprinklers. The total original investment, including the cost of the pump and 6,000 ft. of aluminum pipe, was $11,000. Operating the system required the full time of 1 skilled worker from May to September thus increasing the labor cost. The gross income from the fruit had to be increased by $5,000 per year to justify irrigation. New plantings of berries were injured by irrigation, but established plantings benefited. In the case of black raspberries, the size was increased by 25 percent, new-cane growth increased by 35 percent, all berries matured at full size, and the ripening process was hastened. In strawberry culture it was found that irrigation for frost protection alone carried the added financial load. In apple culture, at least 3 in. of water per application was needed to affect the crop. Heavy irrigation improved the color and texture of the apples, and decreased preharvest drop. Adequate weather forecasting and an unlimited supply of water throughout the season are stressed as the 2 basic requisites for proper irrigation.

327. CULPEPPER, W. S. Conservation irrigation of cotton and other crops in Missouri. Cotton Gin & Oil Mill Press 57(8):20,31. Apr.21,1956. 304.8 C822

Irrigation of cotton increased from 1,000 acres in 1953 to 17,000 by the end of 1955 in 3 Soil Conservation districts. Examples of economic returns from several farms, 1953-55 include: Increases of lint cotton of 230 lb. per acre over nonirrigated, with 3 applications of water at a total cost of $4.80 per acre for fuel and labor; 3/4 bale increase to 3 3/8 bales, with irrigation costs for fuel and labor approximately $6 per acre; an increase of over 350 lb. of lint cotton per acre from irrigation; leveling and ditching costs that averaged $30 per acre for surface irrigation increased cotton yields by approximately 5/8 bale per acre, with fuel and labor cost of approximately $2.80 per acre. Land preparation in the Delta counties cost from $20 to $60 per acre.

328. DAVIS, J. R., and COOK, R. L. Fertilizing through irrigation water. Mich. State Col. Agr. Ext. B. 324,23 p. June 1954. 275.29 M58B

Tells what fertilizers can be profitably applied through irrigation water, and at what stages of growth such fertilization is most beneficial. Nitrogen is readily soluble and therefore may be applied by irrigation water. Also potash. Phosphorus is not readily soluble and should be applied dry at planting time, and never with irrigation water. Manganese, borax, copper, and other of the minor elements may be applied both at planting time and later by irrigation water. Mentions insecticides and fungicides applied through irrigation water.

329. DAVIS, J. R. Frost protection with sprinkler irrigation. Mich. State Col. Agr. Ext. B. 327,12 p. Apr.1955. 275.29 M58B

Sprinkler-irrigation frost protection has been successful in temperatures as low as 20° on vegetables such as tomatoes, cucumbers, peppers, beans, and squash, as well as on berry crops. On taller-growing plants such as corn, celery, pole beans, gladiolus, and hyacinths, however, the weight of the ice formed by the irrigation water may cause breakage. Ordinary irrigation equipment may be adapted to frost control, with only the added expense of an alarm system or thermostat to warn the grower when the temperature is approaching the freezing point. Rates of application are generally lower than for regular irrigation.

Also in Mkt. Growers J. 84(5):8,32. May 1955. 6 M34

330. DAVIS, J. R. If you would irrigate—be sure of enough water. Mich. Farmer 221:229,258. Mar.6,1954. 6 M58

This discussion is devoted almost entirely to groundwater resources. A map is given showing the areas and availability of ground water in Michigan. The Michigan State Geological Survey has considerable information available on ground water.

331. DAVIS, J. R. Irrigating small acreages. Mich. State Col. Agr. Ext. B. 320,31 p. May 1953. 275.29 M58B

Includes a discussion of frost control through irrigation, crops to be irrigated in Michigan profitably, equipment, and costs. Fixed costs are estimated at 15 percent per year of the original cost of the equipment, operating costs are set at 2 to 5 cents per 1,000 gal. of water, fuel consumption at .1 gal. per hp.-hour, and labor at 1 to 2 manhours per acre per irrigation.

332. DRAKE, J. A., and BIERI, F. K. Disposal of liquid wastes by the irrigation method at vegetable canning plants in Minnesota 1948-1950. Indus. Waste Conf. Proc. 6:70-79. 1951. 381 In2

Data available on the irrigation are not sufficiently complete to draw any definite conclusions as to whether or not the crops irrigated by cannery wastes are benefited by the additional water. Concludes that when crops are to be grown on land irrigated with cannery wastes, consideration will have to be given to possible detrimental effects on the plants, such as: 1, Foreign organic matter may accumulate on the plants and provide harborage for harmful fungi; 2, the roots of the plants may rot if the soil remains saturated for too long a time; and 3, plant diseases may be carried from the raw products being processed to the crops being irrigated.

Also in Purdue U. Engin. Ext. Dept. Ext. Ser. 76:70-79. Nov.1951. 290.9 P972

333. DUTTON, C. E. Is irrigation a must for Ohio orchards? East. Fruit Grower 17(5):8-9,13. July 1954. 80 Ea73

Concludes that Ohio peach and apple orchards can use irrigation to good advantage provided there is an economical supply of water. Sprinkler irrigation with aluminum pipe is found to be the best and most economical method. Both apples and peaches, with three and two 2-in. applications of water, respectively, responded to irrigation both in respect to quantity of yield, and size and weight of fruit.

334. GET SCIENTIFIC. Irrig. Engin. & Maintenance 6(3):16,41. Mar.1956. 55.8 Ir722

Two potato farmers near Coshocton, Ohio, recommend that a farmer have the needed knowledge regarding consumptive-use rates of the crops being irrigated and that frequent checks of soil moisture be made to determine the amount and frequency of irrigation. Their cost records indicate that low-pressure sprinklers are the most economical. Their studies indicate that the maximum water-use rate for periods of several days is .36 in. per day for corn, .27 for sweet corn, .22 for potatoes, and .20 for strawberries. Potato yields were 350 bu. per acre without irrigation, 500 bu. when irrigated on a guessing basis, and as high as 800 bu. when irrigated on a scientific basis. The small sprinklers distribute the water more uniformly, with less soil compaction, and with less power than the larger sprinklers.

335. HAMILTON, P. L. When it's dry—they put on a rain! Capper's Farmer 64(7):21,33. July 1953. 6 M693

At an initial cost of $4,100, a Missouri farmer irrigated 70 acres of corn, leaving a 20-acre field unirrigated. The 70-acre field yielded 120 bu. per acre, to 50 bu. per acre for the unirrigated field. Another Missouri farmer, whose crop was ruined by drought in July, replanted 10 acres in soybeans and millet in August, at the same time installing a sprinkler system. Four weeks later he cut 3 tons of hay per acre.

336. HARROLD, L. L. Available moisture for crops. Agr. Engin. 35:99-101. Feb.1954. 58.8 Ag83

Yields of corn at Coshocton, Ohio, in 1953 were increased from 116 to an average of 158.5 bu. per acre when irrigation was applied. Slightly over 4 in. of water were applied per acre. Rooting depths and water-extraction patterns are given for corn.

337. HENRY, C. D., and others. Sewage effluent disposal through crop irrigation. Sewage & Indus. Wastes 26:123-135. Ref. Feb.1954. 293.8 Se8

R. E. Moldenhauer, L. E. Engelbert, and E. Truog, joint authors.

A 3-year study of the use of sewage effluent for irrigation in Wisconsin is reported. A total of 40 in. per acre was applied during the growing season to a grass cover which was quite tolerant of wet conditions. Pasture yields were increased by about 1 ton per acre on the silt loam soil and 2 tons on peat soil. The grass and soil removed virtually all the nitrogen, phosphorus, and potassium from the percolating waters. If the sodium content was high it tended to force more of the calcium and magnesium into the drainage waters.

338. HOGLUND, C. R., KIDDER, E. H., and VARY, K. A. Economics of irrigating in Michigan. Mich. Agr. Expt. Sta. Q. B. 39(2):208-229. Nov.1956. 100 M58S

During 1953, 176 Michigan farmers were interviewed regarding the use of irrigation. In 1956 a limited number of farmers was asked for more detailed information on investments, expenses, and incomes obtained. Most of the irrigation is on the lighter soils and on high-value crops such as berries, potatoes, tomatoes, and other truck crops. The average yields reported for 1952-53 for irrigated and unirrigated were as follows: Potatoes, 405 and 244 bu.; strawberries, 260 and 160 16-qt. crates; raspberries, 73 and 43 crates; tomatoes, 483 and 273 bu.; snap beans, 4 and 2 tons; sweet corn, 786 and 418 doz. ears; cucumbers, 260 and 135 bu.; celery, 887 and 433 crates; melons, 617 and 375 bu.; onions, 637 and 425 bu.; and field corn, 101 and 58 bu. per acre. Field experiments gave an increase of 19 percent in milk production from irrigated pasture. Investments ranged from as low as $700 to as high as $50,000 per farm. A typical farm irrigating 60 acres would have an investment of $7,600 for an annual overhead cost of $11.62 per acre. If one irrigation was applied the total cost would be about $7.50 per acre-inch; for 2 irrigations it would be $4.51 per acre-inch; $3.48 for 3 irrigations, and $2.98 for 4 irrigations. Typical investments and costs are given for farms irrigating 15 acres of truck crops, 30 acres of truck crops, and 75 acres of potatoes.

339. INMAN, W. D. When does it pay to irrigate? Capper's Farmer 64(12):18-19,60-61. Dec.1953. 6 M693

Questions of soil type and texture, availability and expense of extra labor, average rainfall of the area, initial investment, and fertilization needs, must be answered before installing an irrigation system. In some cases it may prove better economy to buy more land. Experiences of an Iowa farmer and a Missouri dairyman with irrigation are recounted.

340. INVESTIGATION of pasture irrigation. In Johns-Manville Corporation. Supplemental irrigation, p. 111. 1-8. New York,1951. 55 J62

At the Dixon Springs Experiment Station in Illinois in 1948, 2 adjacent 5-acre tracts with similar soil types were used in an irrigation experiment. Both were fertilized in the fall of 1947 with limestone and rock phosphate, and seeded with orchardgrass, fescue, Kentucky bluegrass, redtop, and timothy. In the spring of 1948 both were seeded with Ladino clover, and each tract was divided into 7 plots for different soil treatments. One 5-acre tract was left as a check plot to be unirrigated. The other was divided into 2 parts, 1 to receive six 1-in. irrigations, the other to receive six 2-in. applications. The following results were reported: The 2-in. irrigations produced from 311 lb. more dry matter per acre, to 2,251 lb., depending on the soil treatment. The plot receiving superphosphate and potash yielded more than those receiving no additional treatment or only nitrogen. The irrigated tracts as a whole yielded as much as 4,053 lb. per acre more than did the check tract. Animal units per acre were 43.5 percent more on the irrigated than on the unirrigated tract, cattle gains averaged 114 lb. more on the irrigated tract. There was no difference in the 2 tracts in the number of days pastured.

341. IRRIGATING sweetpotatoes. Amer. Veg. Grower 20(6):20. June 1954. 80 C733

Experiments were conducted at the Muscatine Island Field Station in Iowa in 1949-53 with the effects of irrigation and rate of fertilization on the yield of sweetpotatoes. Fertilizers were applied at the rate of 700, 1,200, and 1,700 lb. of 3-9-18 per acre, and water was applied at intervals of 3 1/2 and 7 days. In 1953 the highest yield of No. 1 sweetpotatoes (321 bu. per acre) resulted from a 1,700 lb. fertilization plus irrigation every 3 1/2 days. The next highest (282 bu.) resulted from a 1,200 lb. fertilization with irrigation every 7 days. The latter combination was recommended as more economical, since with the more frequent irrigation nitrogen level might have to be raised in order to gain an economical increase in yield.

342. IRRIGATION in Wisconsin and Michigan. In Johns-Manville Corporation. Supplemental irrigation, p. Regional 4-6. New York,1951. 55 J62

Experiences of various potato farmers. One farmer irrigated 60 acres of potatoes and left 5 acres unirrigated as a check plot. His irrigated potatoes yielded 350 bu. per acre, and sold at $1.00 per bu. His unirrigated potatoes yielded 150 bu. per acre and sold for $.80 per bu. His gross increased income due to irrigation was $230 per acre. Another farmer sold 400 bu. per acre of irrigated potatoes at $.90 per bu., while his unirrigated potatoes yielded 125 bu. per acre and sold for $.70 per bu. His gross increased income due to irrigation was $272.50 per acre.

343. IRRIGATION pays for itself in one year. Prairie Farmer. 128(2):19. Jan.1956. 6 P883C
Irrigation of vegetables is very widely practiced in Michigan. Many times the crop yield is doubled when it is irrigated. Potatoes are one of the most common crops irrigated. In a dry year, 1956, many farmers saved their crops with irrigation. Irrigation will help production but it is expensive and calls for hard work.

344. JOHNSON, G. D. Irrigation—your next big step to more corn? Successful Farming 51(7):43,68. July 1953. 6 Su12
An Indiana farmer irrigated half of 32 acres of corn at an initial cost of $4,000 and an annual cost of $497, or about $30 per acre. The first year the 16 irrigated acres produced 137.2 bu. per acre, the check plot, 41 bu. A $7,500 investment in a sprinkler system on a farm in Iowa paid for itself in 3 years, when corn yield went from an average of 30 bu. an acre to an average of 80 bu.

345. JONES, B. A., and WAKELAND, H. L. Supplemental irrigation of pastures. Agr. Engin. 36:181-184. Mar.1955. 58.8 Ag83
This report covers 6 years (1948 to 1953) of irrigation of grass-legume pastures in southern Illinois. The Dixon Springs Experiment Station is on silt-loam soils. Average rainfall at the station was 21 in. for this period and the average total irrigation was 13 in. for the growing season. Average yields were 1.45 animal units per acre on the irrigated and .96 on the unirrigated. This was a 51 percent increase. When measured in days of grazing the increase was 55 percent, 47 percent when measured in animal gains, and 43 percent when measured in hay production. Average costs were calculated at $24.88 per acre. Increased income was $22.20 an acre when measured in animal gains, and $45 an acre when harvested for hay. Indications are that irrigation of pastures will pay only under very careful management.

346. JUDKINS, W. P. The effect of training systems and irrigation on the yield of everbearing strawberries grown with sawdust mulch. Amer. Soc. Hort. Sci. Proc. 55:277-284. June 1950. 81 So12
Experiments on strawberries with different planting patterns and with irrigation in Wooster, Ohio, showed substantial increases with irrigation with certain planting patterns and no increase with others. Where parent plants and no runners were used the yield was increased 69 percent with irrigation.

347. JUDKINS, W. P. Sprinklers for berries. Amer. Fruit Grower 71(6):9,18-19. June 1951. 80 G85
Shallow-rooted berries such as strawberries will continue to make growth for only 7 to 10 days without rain or irrigation, while deeper-rooted crops such as raspberries will grow 2 to 3 weeks without water. Since there are frequently periods of several weeks without rain in the Eastern United States, irrigation of berry crops is essential if maximum yields are to be obtained. At the Ohio Experiment Station an irrigated plot of strawberries yielded more than 3,500 qt. per acre, while an unirrigated plot yielded less than 3,000 qt. A berry farmer in Tennessee increased the value of his crop by more than $300 per acre with irrigation. Costs of irrigating berry plots have been variously reported, installation costs varying from $50 to $150 per acre. Operating costs of $10 to $15 per acre per year are average.

348. KENNEDY, W. B. Portable sprinkler irrigation system pays for itself in two years. Farm Electrif. 7(3):8. May/June 1953. 335.8 F224
On a truck farm in Illinois where the rain was usually adequate, but where the soil was too light and sandy to hold the water long enough to benefit the crops, sprinkler irrigation was the answer. At an initial cost of $6,000, a system operated by a 20-hp. pump was installed. The pump delivered 200 gal. of water per minute from the Illinois River, and distributed it through 4-in. aluminum pipe. Irrigation assured top production of vegetables, earlier germination of seed, earlier harvesting, and improved quality and marketability of the vegetables.

349. KIDDER, E. H. Automatic irrigation is here. Co. Agent & Vo-Ag Teacher 11(8):32. Aug.1955. 275.28 N213
Automatic irrigation systems have been used on potatoes and celery. These systems are hooked to moisture meters and will turn on when the set level of moisture is reached in the soil. Frost protection by means of sprinklers in Michigan on strawberries has been very successful. Increases in yields from protection during 10 to 11 frosts in 1954 were as much as 300 crates per acre, for an added income of $1,500 per acre.

350. KIDDER, E. H., and SCHLEUSSENER, P. E. Supplemental irrigation in Michigan. Mich. State Col. Agr. Ext. B. 309,31 p. Feb.1952. 275.29 M58B
Irrigation in Michigan should cost not over $7.50 per acre-inch of water per year for high-return crops such as berries. Any cost over this would not justify the investment in terms of returns. For less profitable crops such as hay, pasture, and corn, the cost should not exceed $3.50 per acre-inch per year. Fixed annual costs of sprinkler irrigation can be assumed to amount to 16 1/2 percent of the first cost. Of this 16 1/2 percent, depreciation will account for 10 percent, interest for 2 1/2 percent, taxes for 1 percent, and repairs for 3 percent.

351. KIDDER, E. H., and DAVIS, J. R. Supplemental irrigation on sandy soils in Michigan. Agr. Engin. 34:761-765,768. Ref. Nov.1953. 58.8 Ag83
Irrigation in Michigan has increased so that it is estimated that 1,600 systems are used to irrigate 60,000 acres (1953). From 1948 to 1952 the yields of vegetables averaged 18 percent greater where irrigated on sandy loam soils. Irrigation by sprinklers is effective in frost protection down to temperatures of 22 to 24° F. Potato yields can be increased from 100 to 300 bu. per acre with irrigation.

352. KIDDER, E. H. Tips on buying irrigation equipment. Amer. Veg. Grower 2(6):16-18. June 1954. 80 C733
The most economical and satisfactory types of irrigation equipment for sandy and muck soils of Michigan are described. Sprinkler systems with centrifugal pump (if water is to be taken from lake, pond, or river) or turbine pump (if a well is used) are recommended. For applicators, rotary sprinklers or perforated pipes are suggested. Tips are given on designing an irrigation system.

353. KINGSBURY, T. M. Some problems of irrigation in Indiana. Ind. Acad. Sci. Proc. 64:217-218. 1954, pub.1955. 500 In2
Although irrigated acreage in Indiana more than doubled in 1954 from an estimated acreage of 15,000 in 1953, and with good farm management irrigation substantially increased crop yields, the future of the development of irrigation in Indiana is dependent upon passage of laws regulating the use of water. Irrigated pastures more than doubled their livestock-carrying capacity. Nonirrigated corn production of 40 to 45 bu. per acre was nearly trebled by irrigation.

354. KLEMME, A. Now take Missouri, for instance. Irrig. Engin. & Maintenance 7(5):26-27,30-31,47-48. May 1957. 55.8 Ir722
The Missouri Experiment Station reports an average yield increase of 34 bu. of corn in 1948 to 1955. Yield on the unirrigated plots was 72 bu. per acre, and 106 bu. on the irrigated. A survey in 1956 by county agents showed 546 farmers irrigating 25,266 acres in 1955, and 626 farmers irrigating 46,538 acres in 1956.

355. LAMBETH, V. N. Irrigating the sweet potato; some practical advice to growers. Mkt. Growers J. 84 (12):20,27. Dec.1955. 6 M34
The Missouri Agricultural Experiment Station reports on marketable yields of Porto Rico variety in response to variable irrigation amounts in 1952-54. Yields from irrigation ranged from 280 to 536 bu. per acre, compared to yields of 141 to 308 bu. per acre without irrigation.

356. LANA, E. P., and PETERSON, L. E. Irrigation in Iowa. Mkt. Growers J. 48:13,30. Nov.1954. 6 M34
Studies at the Muscatine Island Experiment Farm in Iowa have shown the effects of different rates of irrigation and fertilization on yields of sweetpotatoes, and the effect of irrigation on yield of muskmelons from 1949 to 1953. Highest yields of sweetpotatoes were obtained over a 3-year period with 7 in. of irrigation water per

season applied at a 5-7 day irrigation interval and with 1,200 lb. of fertilizer. This combination produced an average yield of 227 bu. of No. 1 sweetpotatoes per acre. The high yield of marketable melons was obtained with a 6-day irrigation interval.

357. LUETKEMEIR, O. W., and KOHNKE, H. The influence of supplemental irrigation on corn yields in Indiana. Soil Sci. Soc. Amer. Proc. 1949(14):379-381. 1950. 56.9 So3

Severe droughts have occurred in Indiana in 7 of 10 years during the growing season. Only slight drought conditions occurred in 1947-48 and yield response from irrigation was only 8 to 10 bu. per acre on silt-loam soil. On a sandy soil in 1948 the increase was from 60 to 132 bu. per acre with 5.88 in. of water.

358. MCCULLOCH, A. Maintaining effective soil moisture through irrigation. In Forman, J., and Fink, O. eds. Water and man,p.88-95. Columbus,Friends of the Land,1950. 292 F76

Stresses the importance of scientific application of supplemental irrigation according to soil-moisture level rather than the haphazard application according to calendar dates, or according to the observable condition of the plants. A Bouyoucos block soil-moisture meter was used in experiments at Michigan State College for the scientific application of water. One plot was irrigated according to the meter, and only 4 in. of water were required during the season. On 2 other plots water was applied arbitrarily at the rate of 1 in. per week and 1 1/2 in. per week respectively, these plots receiving a total of 8 to 12 in. during the season. A fourth plot was left unirrigated. The scientifically irrigated plot produced a much higher yield over the unirrigated acres than the more heavily but less scientifically irrigated plots.

359. MCKIBBEN, G. E., and CATE, H. A. Is it practical to irrigate pasture? Hoard's Dairyman 100: 633,641. July 10,1955. 44.8 H65

At the Dixon Springs Experimental Station in southern Illinois, it has been found that at least 12 in. of supplemental water are needed 7 years out of 10. In tests over a period of 7 years, requirements varied from 7 to 21 in., with an average of 14 in. With cattle and sheep as grazing animals, irrigated pasture produced 40 percent more forage, 46 percent more animal gain, and 70 percent greater carrying capacity. Irrigation of 5 acres with 2 in. of water, required 5 1/2 man-hours, and 38 gal. of gasoline. With labor at $.75 per hour, and gasoline at $.25 per gal., the cost, excluding depreciation on and maintenance of equipment, was $1.40 per acre-inch.

360. MCKIBBEN, G. E., and others. Soil moisture availability in irrigated and nonirrigated pastures. Agron. J. 42:565-570. Nov.1950. 4 Am34P

L. E. Gard, C. A. Van Doren, and R. F. Fuelleman, joint authors.

Results of experiments covering 4 seasons at Dixon Springs Experiment Station, Ill., with various plant nutrients and applications of water, and no water. In terms of comparative yields of dry matter per acre, irrigated plots ranged from 3,876 to 7,639 lb.; nonirrigated plots, from 2,618 to 4,846 lb. per acre. Total animal gain on irrigated field was about 2 1/2 times that on nonirrigated; 700 lb. as compared with 270 lb.

361. MANDIGO, J. H. Irrigation for survival in the strawberry business. Mkt. Growers J. 85(12):3,18. Dec. 1956. 6 M34

Stresses frost control as one of the most economically rewarding aspects of irrigation of strawberries in southwest Michigan.

362. MANDIGO, J. H. Small fruits thrive on water. Amer. Fruit Grower. 70(6):16,30-32. June 1950. 80 G85

Sprinkler irrigation for thousands of acres of Michigan's berry-producing sections is a major operation during dry periods in the summer, and when frost threatens. Until 1949, when sprinkler irrigation was successfully used for frost prevention, berry growers suffered severe losses in the spring frosts. In 1949, a strawberry grower of Bangor, using 97 small sprinklers, saved 12 acres of berries which the year before had lost their bloom in a spring frost. His experiences were broadcast by radio to other berry growers in the region, in time to save the major portion of the year's small-fruit crops.

363. MANDIGO, J. H. Sprinklers on increase. Amer. Fruit Grower. West. Ed. 77(6):30-31. June 1957. 80 G85W

In Michigan the average rainfall during June, July, and August is 9 in., while tree fruits require a minimum of 15 in. of water during these vital growing months. Low-angle, under-tree sprinklers are commonly used. Apples and peaches require three 3-in. applications annually to result in larger, better quality fruit, and bigger yields. Cherries require only one 3-in. application, except for frost protection in early spring.

364. MEISTER, R. T. Grower experiences with portable irrigation systems. Amer. Fruit Grower 72(6): 9-10,34-35. June 1952. 80 G85

Case histories of several fruit and vegetable growers show substantial gains with irrigation. A grower in Michigan reports cherry and apple yields increased by as much as 33 percent with irrigation.

365. MILLER, P. E. Spray irrigation at Morgan Packing Company, Austin, Indiana. Purdue U. Engin. Ext. Dept. Ext. Ser. 83:284-287. Jan.1954. 290.9 P972

Spray irrigation for the disposal of cannery wastes, to avoid stream pollution, was installed at this tomato cannery in 1951. Kentucky fescue was planted in a 240-acre field adjacent to the cannery, and a sprinkler was installed. Screened waste was pumped from a 50- by 75- by 6-foot reservoir, through 2,080 ft. of 10-in. pipe, and 1,640 ft. of 8-in. pipe, to 22 portable nozzles. The system not only solved the disposal problem, but indications were that it would prove profitable on its own. The waste-irrigated fescue grew to twice its normal height, and the blades were broader and greener than normal.

366. MUIRHEID, B. F., and JONES, B. A. Irrigation, is it for you? Ill. U. Agr. Ext. C. 763,7 p. May 1956. 275.29 IL62C

Questions and answers for a farmer planning to irrigate in Illinois. Gives approximate cost: Initial outlay for a sprinkler system and a well may be $225 an acre on a 160-acre tract, which would include wells at $30 a foot; pump and power unit about $2,000; the system proper $13,000; soil-moisture meter, $100. Operating costs average $2 for each acre-inch of water pumped from a well.

367. OHIO FORESTRY ASSOCIATION. OHIO CONSERVATION PLAN COMMITTEE. Farm water supplies; final report of the Farm Water Task Force. Columbus, 1955. 11 p. 292 Oh34

Includes brief resumé of irrigation in Ohio as of 1954. Recommends specific steps for water conservation through comprehensive watershed program.

368. ORCHARD IRRIGATION IN MISSOURI. Irrig. Engin. & Maintenance 4(4):30-31. Apr.1956. 55.8 Ir722

By the end of 1955 more than 2,000 acres of Missouri orchards were irrigated by 23 systems costing from $3,000 to $40,000 each. A wide variety of sources of water and power for irrigation is used by these growers. Potentially the yield with irrigation is 500 bu. per acre compared to the average without irrigation of 230 bu. Water requirements are about .2 in. per day during the growing season. In central Missouri the average rainfall is 38 in. Runoff is 4 in.,leaching accounts for 3 in., evaporation for 7 in.,use by grass cover is 7 in.,which leaves only 17 in. for the orchard.

369. OVERHOLT, V. Cornbelt irrigation is increasing. Better Farming Methods 26(5):24,26-27. May 1954. 58.8 B46

Discusses pasture, corn, and fruit irrigation in the Midwestern States, with especial attention to apple and peach orchards in Ohio. It is estimated that only 15 percent of Ohio's farms have available water supplies for irrigation. Quality as well as yield of apples and peaches have been increased with irrigation. One grower reported apple yields increased from 290 to 360 bu. per acre with irrigation, and peach yields increased from an almost complete failure to 492 bu. per acre.

370. PALMER, R. E. Frost protection with sprinkler irrigation systems in strawberries—1955 report. Mich. State Hort. Soc. Annu. Rpt. 85:17-22. 1955,pub. 1956. 81 M58

Describes methods that produced good results on several hundred acres of strawberries in southwestern Michigan in 1954 and 1955. Advantages and disadvantages are discussed. The author concludes that most sprinkler-irrigation systems are capable of providing a high degree of frost control with temperatures as low as 20° F.

371. PLASTIC and aluminum team up for low-cost irrigation. Amer. Fruit Grower. West. Ed. 77(6):24. June 1957. 80 G85W
A Michigan strawberry grower uses plastic pipes as sublaterals off regular aluminum laterals. The plastic cost $21.30 per hundred ft., compared to $65 per hundred for aluminum piping. With 6,800 ft. of plastic he irrigates 27 acres at one time. The cost of a similar footage of aluminum sublaterals would have cost more than $4,000, while the plastic cost only $1,448. Not included is the length of life of the plastic pipe and costs of tripod mounts for the sprinklers.

372. PULVER, G., and STANIFORTH, S. Figuring irrigation costs. Wis. Agr. Col. Ext. C. 519,11 p. June 1956. 275.29 W75C
When information is available on the requirement of the system, source of water, and the pumping and distribution system, a farmer considering irrigation can arrive at approximate total investment costs, annual fixed costs, annual operating costs, and total annual costs. General information for Wisconsin conditions is given for each of these items. An example is given which requires an initial investment of $95 per acre. The annual overhead cost is $15 per acre. Operating costs for fuel and labor are about $2.75 for each irrigation. If 3 irrigations are needed the total cost would be $23.25 per acre. For 4 irrigations the cost would be $26, and for 5 irrigations it would be $28.75.

373. RAIN isn't enough; crop yields and soil moisture tests show that we need more water and need it oftener than rain will provide; even in the best of years, there's need for irrigation. Farm Q. 12(4):60-61,81-83. Winter 1958. 6 F22995
A sweet-corn grower in Ohio irrigated 3 times in 1956 which was a year of almost perfect rainfall distribution, but this irrigation increased his gross returns by 5 to 10 percent. This grower's system cost $7,000 and in 1954 on 45 acres the increased yield and earlier maturity grossed an additional $15,000 or twice what the system cost. Another farmer in Indiana had similar results with field corn, milo, and alfalfa. Double cropping wheat land with milo has been very successful with irrigation, and fertilization. Corn yielded 130 bu. with irrigation, and alfalfa increased from about 4.5 to 7 tons per acre when irrigated.

374. REEVE, P. A. Irrigation studies on the Rader farm—1954. Amer. Soc. Sugar Beet Technol. East. U. S. & Canada. Proc. Region. Mtg. 8:64-65. 1955. 66.9 Am353
Experiments in Michigan in 1954 showed that moisture was not a limiting factor in sugar-beet production. High-fertility plots yielded 20.04 tons of sugar beets per acre when irrigated, and 21.78 tons per acre when not irrigated. Low-fertility plots yielded 17.14 tons per acre when irrigated, and 17.36 tons when not irrigated. There were 20 rainfalls between May 9 and Oct. 17, totaling 15.88 in., and total supplemental irrigation amounted to 2 in.

375. REID, L., and BIRD, J. You can have super yields with irrigation. Better Farming 125(3):31-35,80-82,84-87. Mar.1955. 6 C833
An Iowa farmer began irrigating his corn in 1953. Irrigated corn yielded 65 bu. per acre, nonirrigated about half that much. In 1954, yield was increased to 90 bu. per acre. The irrigation system cost $4,300, an investment of about $40 per acre; operating costs, including depreciation, came to $8 per acre. An Alabama farmer spent $176 per acre for fertilizer and water on his cotton crop which netted him $237.43 per acre. General costs for a system that will irrigate 50 acres under Midwestern conditions will be approximately $5,000 or about $100 per acre, and annual cost of operating it will average $18 per acre, $115 for power, $225 for labor, and $550 for fixed costs. In Missouri it costs from $4.16 to $5.77 per acre-inch to irrigate corn, depending upon extent of acreage.

376. RIGGIN, M. E. Supplemental watering has many 'ifs.' Ind. Farmers Guide 111(4):8. Feb.15,1955. 6 In2
Summary of yields and costs of 2 Indiana farms and results of a controlled experiment in Ohio where the amount of water applied was determined by instruments. On 1 farm 8 1/2 in. of water in 1954 produced an average of 30 bu. of corn per acre. Unirrigated corn in the community produced almost nothing. Equipment investment was approximately $100 per acre and the total cost of applying an acre-inch of water was $2.77, which included fixed costs of $1.89. On the other farm, 5 in. of water produced an average yield increase of 25 bu. per acre. The irrigation system cost about $32 per acre, operating and fixed costs were about $3 per acre-inch. In 1953 the cost per acre-inch was $4.45. In Ohio, a corn plot irrigated according to water requirements with 4 1/2 in. produced 1,668 doz. ears for a profit of $264. An unirrigated control plot yielded 229 doz. ears.

377. ROBERTS, H. Sprinkler irrigation. Wis. Hort. 40:134-135,167. Feb.-Mar.1950. 80 W752
Irrigation of strawberries by more than 20 Wisconsin growers over a 3-year period has proved very satisfactory. Frost protection down to 12° has been obtained for a period of 5 to 6 hours with sprinklers.

378. ROBERTS, W. J. Irrigation in Illinois. Ill. Water Survey. Rpt. Invest. 11,11 p. 1951. 292.9 IL6R
A survey in 1951 showed 9,000 acres of farmland being irrigated in Illinois, on 164 farms mostly in eastern Cook and Kankakee Counties. Nearly all the systems were sprinkler systems with aluminum pipe, and averaged $72 per acre in initial cost, representing a total investment of over $500,000. The 5 crops irrigated were truck, flowers, pasture, corn, and forests. Gladioli growers in Kankakee County had been irrigating since 1926. Water sources were wells and ponds primarily, but in some counties water was pumped from rivers. The most expensive system found was that of a corngrower near El Paso, Ill., where 160 acres had been irrigated at a total original cost of $37,400, or over $233 per acre.

379. ROE, H. B., and PARK, J. K. Supplemental irrigation. In Johns-Manville Corporation. Supplemental irrigation, p. Minn. 1-4. New York,1951. 55 J62
A survey of 150 irrigated farms in Minnesota in 1937 showed the initial cost of oscillating sprinkler systems to be about $120 per acre, and of the circular-spray systems to be about $50 per acre. Fixed costs for the circular-spray system came to $4.83 per acre per year, and operating costs amounted to $11 per year, a total annual cost of $15.83 per acre per year. Crops that have been successfully irrigated in Minnesota, bringing a reported increase in income up to $400 per season, are berries, bush fruits, spinach, lettuce, cabbage, cauliflower, cucumbers, squash, melons, radishes, carrots, beets, onions, tomatoes, peppers, sweet corn, peas, and beans.

380. RUBEY, H. Supplemental irrigation for Missouri and regions of similar rainfall. Mo. Engin. Expt. Sta. B. 33,rev.,73 p. Ref. Feb.15,1953. 290.9 M69
Includes costs and profits. The major expense for surface irrigation is incurred for labor and farm-equipment usage, whereas sprinkler systems require less labor and more cash. The original costs for sprinkling 80 acres come to $8,000 ($1,500 for pump and motor, $6,500 for mains and laterals) or $100 per acre. The original costs for surface irrigation come to $4,800 ($2,000 for land leveling, $1,200 for pump and motor, $1,000 for field ditch, and $600 for miscellaneous equipment) or $60 per acre. Annual costs for both systems average about $18 per acre. With sprinklers, depreciation, interest, taxes and insurance come to $10 per acre compared to only $4 for surface irrigation. Power for sprinklers amounts to $3 per acre, compared to only $1 per acre for surface systems. But maintenance of surface systems amounts to $3 per acre compared to only $1 for sprinklers; and labor for surface systems comes to $10 per acre compared to only $4 for sprinklers. Cites several familiar examples of increased profits due to irrigation in Missouri and other areas of the humid East.

381. RUDOLPH, V. J., and DILS, R. R. Irrigating trees with cannery waste water. Mich. Agr. Expt. Sta. Q. B. 37:407-411. Feb.1955. 100 M58S

Seedlings of boxelder and cottonwood and cuttings of willow and balsam poplar were planted on an 8-acre area in Michigan. Water was distributed through a portable-pipe irrigation system using large-nozzle rotary sprinklers. First-year survival and growth results, spring 1954, are given in a table. Percentage of survival in watered and control areas respectively, were: Native willow 58 and 18, hybrid willow 48 and 4, cottonwood 32 and 21, boxelder 46 and 79, balsam poplar 4 and 10. Aver- and maximum height of trees on watered and control areas are given.

382. RUPP, R. G. Water when you want it, where you want it. Farmer [St. Paul] Gen. Ed. 69(12):1,16,18. June 16,1951. 6 F2211
A 35-acre plot used for corn trials by a Minnesota farmer in conjunction with University of Minnesota agricultural engineers yielded 33 bu. per acre with no water or fertilizer; yields were increased with various combinations of water and fertilizer, to 87 bu. with the application of 420 lb. of nitrogen per acre. Cost was $17.28 per acre for irrigation, based on depreciation of a $3,000 system over a period of 15 years, and included interest, power, labor, maintenance and overhead. Net profit from the best combination (irrigation and 60 lb. of nitrogen) was $58.96 per acre. Consideration should be given to reducing labor cost by installing laborsaving irrigation systems. Other successful irrigation and fertilizer combinations used on alfalfa and oats are briefly discussed.

383. SISSON, D. R. How's irrigation doing in the Midwest? Irrig. Engin. & Maintenance 6:18-19. Jan. 1956. 55.8 Ir722
Discusses average drought frequencies for a 45-year period in Indiana, acres irrigated in Indiana as compared with a total acreage in 8 Midwestern States, and crops which respond favorably to irrigation. Corn studies at Purdue University Agricultural Experiment Station in 1949, 1952-54, resulted in yields which ranged from 40 to 80 bu. per acre not irrigated, and from 130 to 144 bu. per acre, irrigated. Fields of 5 to 6 tons of alfalfa hay may be expected when irrigated, as compared with 2 1/2 to 3 1/2 when not irrigated.

384. SISSON, D. R. Some principles of agricultural irrigation. Purdue U. Engin. Ext. Dept. Ext. Ser. 89:519-526. 1955. 290.9 P972
Considers drought periods in Indiana over a 45-year period, extent of irrigation in Indiana, design of irrigation systems, and problems in use and management of an irrigation system. Table shows yields of corn in bushels per acre for irrigated and nonirrigated land at Purdue Experiment Station, 1949, 1952-1954. In 1949 irrigated corn yielded 132 bu. per acre compared to 60 bu. for nonirrigated corn. In 1952, 1953, and 1954, the yields were 130, 144, and 130 bu. per acre respectively for irrigated corn, and 55, 40, and 80 bu. per acre respectively for unirrigated corn. For the 4 years irrigation increased yield an average of 75.25 bu. per acre.

385. TEICHMAN, W. W. Some things I know and don't know about irrigating orchards. Mich. State Hort. Soc. Annu. Rpt. 85:22-23. 1955,pub.1956. 81 M58
A Michigan orchardist who had invested in an irrigation system primarily to insure that early fertilizer be made available to apple and cherry trees, found that prefrost irrigation made Montmorency cherries more resistant to cold, perhaps equal to a moderation of 2 or more degrees of air temperature.
Also in East. Fruit Grower 20(5):8,15. July 1956. 80 Ea73 with title: "Known and unknown" about irrigating orchards.

386. TINDALL, C. Irrigation earns its place in Missouri farming. Mo. Rur. 95(18):4-5,16. Sept.25,1954. 6 R8891
At the Southeast Missouri Irrigation and Drainage Field Day, yields from irrigated cotton estimated at 880 lb. of lint to the acre, and 425 lb. from nonirrigated, were demonstrated. Irrigated-corn yields increased 25 bu. per acre in tests in central Missouri since 1948. A survey of 55 farmers reported an increase of 38 bu. per acre in a dry year. Soybeans increased 14 bu. per acre in 1954 and 6.3 in 1953. In cotton tests in Missouri, 1953 yields increased 2,044 lb. of seed cotton per acre when irrigated. A survey of 10 irrigation farmers showed an average increase of 1/2 bale per acre. Tests in Arkansas report an increase of .45 bales per acre. Approximate costs for a sprinkler system are $40-$150 per acre. An application of 6 in. of water will cost about $15-$35 per acre per year.

387. TINDALL, C. Irrigation paid this year. Mo. Rur. 93(17):4-5,38. Sept.13,1952. 6 R8891
Experiences of various Missouri farmers show the worth of irrigation. A Barry County farmer in the drought of 1952 harvested 1,300 bales of excellent hay from 10 acres of irrigated fields. Another farmer saved 70 acres of corn that would have perished in the drought without irrigation. A tomato canner produced enough tomatoes from one field to keep his canning factory busy all summer, thanks to irrigation. A dairyman saved $15 a day on feed, with irrigated pasture, and his milk production jumped 10 gal. a day.

388. TUSSING, E. B. Irrigation — its effect on pore space, set and yield of potatoes. In Johns-Manville Corporation. Supplemental irrigation, p. Ohio 1-6. New York, 1951. 55 J62
Research on potato irrigation at the Ohio State University Farm. Cobblers were used, and the field was divided into 3 parts, 1 part to receive no supplemental irrigation, 1 part to receive 1 in. of added water whenever the evaporation reached 1 in., and 1 part to receive 1.5 in. of irrigation for each inch of evaporation. Thirteen applications were given the 2 irrigated plots between Aug. 5 and Oct. 15. At harvest the following results were observed: Total yield, in bu. per acre; unirrigated, 64; 1-in. irrigations, 355.5; 1.5-in. irrigations, 355.8. Average number of tubers per hill; unirrigated, 3.54; 1-in. irrigations, 6.84; 1.5-in. irrigations, 7.65. Average weight of tubers per hill; unirrigated, .42 lb.; 1-in. irrigations, 1.96 lb.; 1.5-in. irrigations, 1.998 lb.

389. U. S. MISSOURI BASIN SURVEY COMMISSION. Missouri: land and water; the report. Washington,1953. 295 p. 173 M694M
Ch. 4, Water supply and irrigation, cites the need for irrigation in the area to increase the future food supply. Research is needed to determine if pump irrigation is economically sound in the humid areas of Missouri and Iowa, where both surface and underground water supplies are available. Subhumid areas are more drastically affected by droughts when they occur than are the drier areas where practices are adapted to drought conditions. The cost of irrigation must be weighed against its occasional use, but the gradual extension of supplemental irrigation into the subhumid areas seems certain.

390. U. S. SOIL CONSERVATION SERV. UPPER MISSISSIPPI REGION. Farm planners' engineering handbook for the Upper Mississippi Region. U. S. D. A. Agr. Handb. 57,various paging. June 1953. 1 Ag84Ah
Pt. 12, Irrigation, 15 p. Information given regarding needs for irrigation includes: Tables of probable average number of periods of deficient rainfall per year for Illinois, Indiana, Iowa, Michigan, Minnesota, and Ohio; comparison of physical and water-holding properties of soils, water requirement for some common field crops, root-working depths and values of peak daily use of soil moisture for optimum yields of common irrigated crops; determination of soil moisture by the "feel" method. Also described are general types of irrigation and their adaptation to the region, and average costs of equipment.

391. WHITAKER, R. W., and LYTLE, W. F. Supplemental irrigation of pasture. Agr. Engin. 32:163-165. Mar.1951. 58.8 Ag83
Results of irrigation of pasture at the University of Illinois' Dixon Springs Experiment Station for 1948 and 1949 show yield increases from 54 to 140 lb. animal gain per acre in 1948, and from 391 to 533 lb. in 1949. It was very dry in 1948 and 12 in. of irrigation water per acre was required, while in 1949 the requirement was only 6 in. of water per acre. Irrigation costs were $3.83 per acre-inch, of which 20 percent was labor. In 1948 the net loss was $24.46 per acre, and in 1949 the net gain was $12.52. It is essential that proper fertilization be applied to obtain full benefits of irrigation.

392. WHITT, D. M. Effects of supplemental water on field crops. Mo. Agr. Expt. Sta. B. 616,8 p. Feb.1954. 100 M693

Experiments at the Missouri Agricultural Experiment Station in 1953 with irrigation of corn, soybeans, cotton and wheat, produced the following results: Corn — highest yield, 76.9 bu. per acre, resulted when 3 irrigations totaling 5.52 in. were applied, compared to 34.2 bu. without irrigation; irrigated corn averaged .30 lb. per ear in weight, unirrigated corn, .15 lb., or half as much. Soybeans— unirrigated beans yielded 16.6 bu. per acre, and it required 4,493 beans to make a pound; irrigated beans yielded 30.6 bu. per acre, and only 2,993 beans weighed a pound. Cotton — with no irrigation the total yield per acre was 1,414 lb. of which 95 percent was yielded at the first picking; irrigated cotton yielded a total of 3,458 lb. per acre, of which only 44 percent was yielded at the first picking, while 52 percent was yielded at the second picking; irrigated cotton produced bolls 60 percent heavier than those of unirrigated cotton. Wheat - there was a yield difference of only 2.3 bu. per acre, irrigated wheat yielding 53.9 bu. to 51.6 bu. for unirrigated wheat.

393. WHITT, D. M. Soybean irrigation studies in Missouri. Soybean Digest 14(9):10-11. July 1954. 60.38 So9
Research at the Midwest Claypan Experimental Field in 1953. The soil was a Mexico silt loam, underlain by a hard claypan 12 to 14 in. below the surface. Rainfall was adequate until pod-filling time in mid-August, and an irrigation of 4.7 in. was applied to half the field on Aug. 21. In September the irrigated field yielded 30.6 bu. of beans per acre, compared to only 16.6 bu. per acre for the unirrigated half. The irrigated beans were 50 percent larger than the unirrigated beans, and the oil content was 2.2 percent greater. The percentage of acetone insolubles was 3 times as great in the unirrigated beans.

394. WILLIAMS, G. G. Field trials of irrigation for corn. Amer. Seed Trade Assoc. Hybrid Corn Div. Rpt. Hybrid Corn Indus. Res. Conf. 10:91-98. 1955. 59.9 Am32
Lists 10 recommendations for irrigating corn under Corn-Belt conditions. A few examples of yields are included. An Indiana farmer reports an increase of 50 bu. per acre with irrigation. A Missouri farmer in 1955 irrigated 23 acres of bottomland and harvested 197 bu. per acre while an adjoining unirrigated but otherwise similar field yielded 99 bu. per acre. Another Indiana farmer on a very sandy soil got only 20 to 50 bu. per acre without irrigation, and 110 to 122 bu. per acre with irrigation.

395. WILLIAMS, G. G. There's a big difference between irrigation farming and supplemental irrigation. Agr. Leaders' Digest 37(4):14-27. Apr.1956. 275.28 Am3
Systematic irrigation farming increased corn yields in Indiana and Missouri. In 1954 a Missouri farmer netted $56.82 per acre from 23 acres of fertilized and irrigated corn which yielded an average of 125 bu. per acre; in 1955 he increased the yield to 197 bu. per acre and netted $125.42 per acre. With irrigation an Indiana farmer harvested between 125 and 140 bu. of corn per acre the past 4 years; another grew more than 100 bu. per acre, while unirrigated corn nearby yielded only 35 to 40 bu. per acre; another farmer averaged 135 bu. per acre after irrigation.

396. WILLIAMS, G. G., and JONES, U. S. When 2 plus 2 is more than 4. Plant Food Rev. 2(4):18-21. Winter 1956. 57.8 P694
Phosphorus and potash do not become available to plants unless sufficient water is present in the soil. In a test by the Plant Food Institute, irrigation alone increased yields 25 percent, and phosphorus alone increased yields by 25 percent. Irrigation and phosphorus together increased yields, not 50 percent, but 100 percent. A Missouri farmer harvested 197 bu. of corn per acre with irrigation, while a similarly fertilized check plot, unirrigated except by rainfall, yielded only 99 bu. per acre, of inferior quality. A potato farmer harvested 96 percent No. 1 grade potatoes with irrigation, while a heavily fertilized, unirrigated check plot yielded only 75 percent No. 1 grade potatoes.

397. WILLOBEE, J. Whip drought with irrigation. Ill. State Hort. Soc. Trans. 87:117-120. 1953. 81 IL6
"Irrigation today is economically sound in the fruit industry." Stresses the need for an adequate water supply — enough to give 5 to 10 gal. per minute per acre — to justify irrigating orchards. Sprinkler irrigation is recommended for Illinois fruit orchards.

398. WILLOBEE, J. W. Frost control by irrigation. Ohio Veg. & Potato Growers Assoc. Annu. Proc. 40:59-62. 1955. 75.9 Oh3
An experiment in regulating the temperature of strawberries by the application of water by sprinklers in 32° F. or lower conditions. In Michigan there are 6,000 acres of strawberries under irrigation frost control. The initial cost of a system is estimated to be $525 per acre, including $125 for a pumping unit, $300 per acre for lines including sprinklers, and $100 per acre for main lines. The cost of an alarm system to warn the grower when the outdoor temperature has reached 35° F. is given.

399. WOOD, I. D. Irrigation in the Middle West. Agr. Engin. 38(6):418-421. June 1957. 58.8 Ag83
The general drought the United States has suffered since 1949, together with the higher cost of crop production, has been the chief factor in the growth of irrigation in the Middle West. With the average cost of fertilizers having risen from $60 per farm in 1941 to $780 per farm in 1955, crop failure has become more and more of a catastrophe. Irrigation is the safeguard. The acreage under irrigation in Missouri, Iowa, Minnesota, Illinois, Indiana, Michigan, Wisconsin, and Ohio has increased from 43,949 in 1950 to 528,000 in 1956.

400. WOOD, I. D. Land preparation for irrigation and drainage. Agr. Engin. 36:597-599. Nov.1951. 58.8 Ag83
Land leveling for irrigation and drainage cost $67.50 per acre where gated aluminum pipe was used, and $48.75 where siphon tubes from ditches were used in Iowa on the Missouri River Bottomland.

401. WORMLEY, G. W. Pasture irrigation—can you make it pay? Farm J. 79(8):29,132. June 1955. 6 F2212
Experienced farmers and dairymen offer these suggestions: Pasture irrigation will usually show a better profit with dairy cattle than with beef cattle; before irrigating, try using more fertilizer on heavy soils; graze in rotation; use fast-growing pasture crops; use irrigation on another crop. Following are some of the examples used to illustrate their suggestions: By strip-grazing 10 acres of irrigated pasture in Indiana, 18 cows produced 15,000 lb. of milk per month throughout the summer. This dairyman considers 7,500 lb. per month of this milk, valued at $262 per month, as bonus due to irrigation. The Dairy Experiment Station at Lewisburg, Tenn., reports a net return of $100 per acre from irrigated-pasture-grazed cows, in 4 -year tests. Six-year cattle-fattening tests by Illinois scientists resulted in a shortage of $2.70 per acre in paying irrigation operating costs. In Virginia, experiments over a 5-year period with irrigated pastures resulted in an average of over $50 worth of extra beef per acre.

SOUTH ATLANTIC STATES

402. ALLABAND, W. A. SCS and Virginia's irrigation. Irrig. Engin. & Maintenance 6(10):13,27. Sept.1956. 55.8 Ir722
Farmers in Virginia are rapidly turning to irrigation, as shown by the assistance of Soil Conservation Service on 408 reservoirs in 1955. One tobacco grower reports a 5-year average yield of about 2,200 lb. per acre, which is nearly double his previous average without irrigation.

403. ALLEN, C. W. The prospect for investment opportunities in irrigation: An economic viewpoint. Va. Polytech. Inst. Agr. Ext. Va. Farm Econ. 145:9-11. Feb. 1956. 275.29 V813
Annual fixed costs are estimated as $9.66 and operating costs as $9.60 per acre per year to irrigate 80 acres, with an $8,000 system. Yield expectancy as determined by 3-year tests at Blacksburg, Va. is an increase of about 24 bu. of corn per acre, or an increase in gross of approximately $36 per acre during seasons when irrigation is needed.

404. BANTA, E. S. Judgment is the key to successful irrigation. Amer. Veg. Grower 1(8):10-11,20-21. Aug.1953. 80 C733
Knowing when and how much to irrigate in the humid regions, and knowing which plants require light and frequent, and which heavy and infrequent, watering, is one of

the keys to success. Organic content and type of soil, and rooting habits and transpiration rate of plants, need to be known. The reward is increased yield and improved quality of the crop. Vegetables grown under irrigation are tastier and richer in food value. Experience of a Maryland farmer who increased yield of turnips by 1 ton, or $40 per acre, through irrigation, is recounted.

405. BARNES, W. C. Irrigation proves good—but not perfect. Atlantic Coast Line Agr. & Livestock Topics 7(2):2,4. Feb.1955. 6 At63
The superintendent of the Truck Experiment Station, Clemson College, S. C., mentions some shortcomings. Irrigation is not so effective as an equal amount of rain. Hot dry weather causes greater losses in evaporation and transpiration, and some wilting and blossom drop occur even when sufficient water is supplied by irrigation. There are certain periods during plant growth when irrigation is beneficial, others when it is not. In contrast, in other tests, additional water applied only once or twice has produced results of increases in yield of 20 to 50 percent on such crops as sweet corn, squash cucumbers, tomatoes, Irish potatoes, and beans.

406. BARRON, L. Put your farm water to work. Natl. Future Farmer 2(3):46-52. Spring 1954. 6 N2122
The Georgia Agricultural Extension Service showed an example of $94 an acre installation cost in 1946, and an annual cost of $30 an acre for a 20-acre sprinkler system. Yield increases were as much as 35 lb. more milk a day per acre, 400-lb.-an-acre increase in tobacco, and tomato yields up from 100 to 2000 bu. The Tennessee Agricultural Experiment Station showed that the irrigated half of a pasture averaged 49 percent more cow days of grazing, 54 percent more milk production, and 38 percent more income than the unirrigated half, or an average increase in net return of $115.53 per acre.

407. BENNETT, R. R., and others. Field irrigation of tobacco. N. C. State Agr. Col. Ext. C. 388,35 p. Nov. 1955. 275.29 N811
S. N. Hawks, H. H. Nau, C. J. Nusbaum, M. S. Williams, C. W. Williams, and H. M. Ellis, joint authors.
Contents: Some tobacco irrigation principles, by R. R. Bennett, S. N. Hawks, and H. H. Nau; Black shank and irrigation, by C. J. Nusbaum; Irrigation rental agreement, by M. S. Williams and C. W. Williams; Water supply and equipment, by H. M. Ellis. Figures, except repairs, given in example of share-agreement costs and returns are averages reported by farmers in 1952-53 irrigation survey, and include the following: Increase in income per acre, $306; total annual costs, $34.20 (overhead, $24.38 and operating, $9.82). Statistics compiled from survey of farmers give: Capacity of equipment purchased and irrigation procedure, average cost of water supply, average cost of equipment, average capital outlay, and increase in acre value from irrigation.

408. BENNETT, R. R. Irrigate your tobacco. Farm & Ranch-South. Agr. Upper So. Ed. 84(4):9,33. Apr.1954. 6 T31
Irrigation experiments conducted by the North Carolina Agricultural Experiment Station have demonstrated that quality of tobacco is improved, stand and uniformity of growth greatly influenced, early maturity improved, and yields increased as much as $300 per acre, by irrigation.

409. BLACK, A. P. Water requirements in Florida. Engin. Prog. U. Fla. 9(4):14-18. Apr.1955. 290.8 En37
In 1954 irrigation-water use in Florida was 191 billion gal. per year, or 7,000,000 acre-inches. It is estimated that by 1970 these figures will grow to 1,250 billion gal., and 46,000,000 acre-inches. Between 1944 and 1954 the number of irrigated farms in Florida increased from 3,800 to 7,600. The latter figure included 75,000 acres of pasture, 161,000 acres of citrus, 230,000 acres of truck crops, 7,000 acres of tobacco, and 3,000 acres of corn. By 1970 it is estimated field-crop irrigation will call for an additional 7,000,000 acre-inches of water, and pasture irrigation will call for an additional 26,000,000 acre-inches per year.

410. BLANCHARD, J. W. Georgia bank an ally in progressive program against drouth. Amer. Hereford J. 46(17):62,66. Jan.1,1956. 43.8 Am32
Irrigation financing. Includes conditions necessary for irrigation loans, which were as follows: 1, A constant and dependable source of water; 2, proper engineering of the equipment to suit particular needs; 3, crops and soils must be suited to irrigation; 4, a productive operation worth putting more money into; and 5, the equipment must pay for itself through increased yields in years of normal rainfall as well as in years of drought.

411. BRASHER, E. P. Irrigating vegetable crops in 1950. Del. State Bd. Agr. B. 40(5):55-58. 1951. 2 D37B
Experiments by the University of Delaware and the Soil Conservation Service on the effects of irrigation on vegetable growth during a season of normal rainfall in Delaware gave the following results: Marketable yield of cantaloupe increased 30.70 percent; lima beans, 28.63 percent; sweet corn, 20.33 percent; snap beans, 18.78 percent; sweetpotatoes, 16.80 percent, and peppers, 5.46 percent. The yield of tomatoes was smaller with irrigation than without, although there was an increased growth of foliage.

412. BUIE, T. S. Land! water! people! Better Crops Plant Food 38(9):25-26,48. Nov.1954. 6 B46
Deals mostly with increased demands on water supply. Briefly refers to tests at South Carolina Agricultural Experiment Station where, over a period of 3 years, the yield of corn was more than doubled, and cotton and tobacco yields were increased 41 and 44 percent respectively, with irrigation.

413. BURKS, E. Farm irrigation will pay off in North Carolina. Farmers Fed. News 34(9):4,16-17. May 1954. 280.28 F225
Irrigation of tobacco pays greater returns in North Carolina than does that of any other crop. Late in a dry season, a farmer of Alamance County who was losing his tobacco crop in the drought, went out and bought sprinkler equipment to cover 18 acres. The last-minute irrigation saved his crop, and paid him sufficient to pay for the equipment as well as for the digging of 3 ponds, and for labor. The number of irrigated tobacco acres doubles every year in North Carolina. In 1953, 2,500 acres were irrigated, and it was estimated that in 1954 there were 5,000 acres irrigated.

414. CARREKER, J. R., and HUSTON, W. E. Designing sprinkler irrigation systems. Ga. Agr. Col. Ext. B. 588,26 p. May 1955. 275.29 G29B
"This bulletin...serves as a guide for designing, financing and purchasing irrigation systems." —Foreword.
Discusses farm features affecting system design, rainfall, moisture-withdrawal rates for various crops, and layout of systems.

415. CARREKER, J. R. Need for research. Cotton Gin & Oil Mill Press 55(17):56-57. Aug.14,1954. 304.8 C822
Continued research by industry to reduce the costs of production and marketing of irrigation equipment is essential so that farmers can buy irrigation equipment with less capital than is now required. More research by agriculturists is also required to permit reliable answers to questions on the costs and returns of cotton irrigation in the humid States. A South Carolina study showed that 2 irrigations totaling 2.6 in. of water increased seed-cotton yield by 655 lb. over unirrigated cotton, and increased fiber length by 1/16 in. The staple length alone increased the value of the cotton more than the cost for labor and fuel for irrigation. The cost was $2.00 per acre-inch of water applied.

416. CARREKER, J. R. Water requirements for cotton. (Abs.) Assoc. South. Agr. Workers Proc. 54:54-55. 1957. 4 C82
Irrigation of cotton since 1952 at Watkinsville, Ga., has increased yields from 1,952 lb. without irrigation to 3,621 lb. with light irrigation, 3,463 lb. with medium irrigation, and 3,257 with heavy irrigation. These yields are in pounds of seed cotton per acre. In 1956 the evapotranspiration rates increased from an average of .12 in. per day without irrigation, to .17 in. with light irrigation, .22 in. with medium irrigation, and .26 in. with heavy irrigation. Maximum yield with cotton was with .16 in. moisture in the light irrigation treatment. Two and five-tenths in. was in the soil, 8 came from rainfall, and 5.7 in. from irrigation.

417. CHAMBLEE, D. S. Moisture relationships and response to irrigation of several forage species. (Sum.) South. Pasture & Forage Crop Impr. Conf. Rpt. 10:23. 1953. 60.19 So83

Experiments at the North Carolina Agricultural Experiment Station. Carpet, Bermuda, and Dallis grass yielded 2 to 3 times more top and root growth when saturated every 5 days than when saturated every 15 days. Orchardgrass produced much higher yields when watering was withheld until the soil moisture reached the wilting percentage than when frequent irrigations were applied. Alfalfa responded to frequent irrigation. Ladino-tall fescue, in 1951-52, yielded 69 percent more days on pasture, and 52 percent more TDN, when irrigated.

418. CHOATE, R. E., MCCLOUD, D. E., and HAMMOND, L. C. Depth and frequency of supplemental irrigation of pastures. Soil Sci. Soc. Fla. Proc. 12:143-153. 1952. 56.9 So32

Results of a project undertaken at the Florida Agricultural Experiment Station in 1951-52, involving 4 depths of wetting, 2 soil-moisture ranges, and 4 pasture species. While the differences in yield were not statistically significant, definite trends were apparent. Most species gave a greater yield when irrigated at a tension of 200 cm. than at a tension of 800 cm. Controlling irrigation by tension measurement in the 18- 24-in. zone resulted in yields only slightly greater than yields from the nonirrigation treatment. None of the irrigation treatments extended the growth period of the clovers.

419. CLARK, F., and MYERS, J. M. The effect of rates of irrigation, fertilizers and plant spacing on the yield and quality of flue-cured tobacco in Florida. Soil & Crop Sci. Soc. Fla. Proc. 16:249-257. 1956. 56.9 So32

Tests at the Florida Agricultural Experiment Station in 1953-55 showed that fertilizer requirements for irrigated tobacco were approximately the same as for unirrigated. Plantings of 7,500 to 10,000 plants per acre gave better results with irrigated tobacco than did plantings of 12,500 per acre. Medium irrigation (11 to 15 applications totaling 8 to 10 in. of water) produced a higher yield and better quality than did heavy irrigation. In 1955, medium irrigation produced 2,362 lb. per acre, of which 73.3 percent was of high quality. In the same year heavy irrigation produced 2,169 lb. of which only 72.6 percent was of high quality. The dollar values of the 2 crops were $1,173 and $1,068, respectively. Light irrigation in the same year produced 2,088 lb. per acre, of which 70.8 percent was of top quality. Its value was $982 per acre.

420. CLARK, F., and others. Irrigation, fertilization and fumigation of fluecured tobacco. (Abs.) Assoc. South. Agr. Workers. Proc. 48:52. 1951. 4 C82

H. C. Harris, R. W. Bledsoe, and J. M. Myers, joint authors.

Experiment at the Florida Agricultural Experiment Station "designed to determine the effects of three different levels of irrigation,two levels of fertilizer, two methods of fertilizer application, four culture treatments and their interactions" on flue-cured tobacco. Results are for two years. Yields in figures are not given.

421. CLARK, F., and others. Yield and quality of flue-cured tobacco as affected by fertilization and irrigation. Fla. Agr. Expt. Sta. B. 572,32 p. Mar.1956. 100 F66S

J. M. Myers, H. C. Harris, and R. W. Bledsoe, joint authors.

Experiments were conducted at the Florida Agricultural Experiment Station in 1949-51 to study the influence of rates of fertilization and irrigation on yield and quality of flue-cured tobacco. Total yield and quality were increased by irrigation during the 3 years, but in 1950 the effect of irrigation alone was slight. Evidence was furnished that without irrigation a higher quality of tobacco is produced with 800 lb. of fertilizer per acre than with 1,600 lb., while with irrigation, 1,600 lb. per acre produced more and better tobacco than did 800 lb. It was found that 13 to 15 in. of water (rainfall and irrigation) were necessary to produce a good crop of quality tobacco. Irrigations of 1/2 in. were economically more satisfactory than heavier applications.

422. CROSSAN, D. F., and LLOYD, P. J. The influence of overhead irrigation on the incidence and control of certain tomato diseases. Plant Dis. Rptr. 40:314-317. Apr.15,1956. 1.9 P69P

Field plot experiments in Delaware indicate overhead irrigation increased incidence of tomato anthracnose and fruit rot, decreased incidence of blossom-end rot, and caused significant increase in marketable yield.

Abs. in Phytopathology 46:18. Jan.1956. 464.8 P56

423. DAVIS, E. H. Irrigate for more profits. (Abs.) In Johns-Manville Corporation. Supplemental irrigation, p. Ga. 14-19. New York,1951. 55 J62

Results of experiences of some 85 Georgia irrigation farmers, together with Georgia Experiment Station findings, are summarized. Alfalfa increased 1 to 2 tons per acre after irrigation. Bush string beans increased from 125 bu. per acre without irrigation to 260 bu. per acre with. Collards increased from no crop at all in some seasons to 1,200 lb. per acre in an irrigated clay loam, and to 6,000 bunches per acre in an irrigated sandy loam. Cabbage: 500,000 head per acre without irrigation, 1,000,000 head after irrigation. Escarole: 400 bu. per acre without irrigation, 600 bu. with irrigation. Gladiolus bulbs: Complete crop loss in some seasons without irrigation, 75,000 bulbs per acre with irrigation. Ladino-clover seed: 35 lb. per acre with irrigation, no crop at all without irrigation. Lima beans: 40 bu. per acre without, 80 bu. per acre with irrigation. Onions: 100 to 200 percent increase after irrigation. Peaches: All fruits medium to large with irrigation, all fruits small to medium without irrigation. Dairy pasture: 35 lb. increase in milk per acre per day after irrigation. Beef-cattle pasture: 2- to 3-head increase in grazing per acre. Pine seedlings: 125,000 per acre without irrigation, 500,000 with. Raspberries: 100 to 200 percent increase in yield with irrigation. Tobacco: 1,000 lb. per acre without irrigation, 1,400 lb. with. Costs and returns are not given in dollars and cents.

424. DAVIS, J. R. Future of irrigation in humid areas. Amer. Water Works Assoc. J. 48:982-990. Ref. Aug.1956. 292.9 Am32J

Irrigation in Georgia in 1953 resulted in net increases of $399.50 per acre for sweetpotatoes, $133.50 per acre for tomatoes, and $62 per acre for corn; in Missouri in 1953, in net increases of $32.10 per acre for corn and $6.80 per acre for soybeans; in net increases of $102.36 on irrigated pastures in Tennessee, and $282 per acre on tobacco in Virginia. In 1955, a yield of 300 bu. of corn per acre was attained in Mississippi. Strawberries in Michigan showed a possible gross profit of $1,500 per acre.

425. DREILING, F. R. Why growers are turning to sprinklers for tree fruits in Virginia. Amer. Fruit Grower. West. Ed. 77(6):10-11. June 1957. 80 G85W

More than 1,500 acres of apples and peaches are being irrigated by sprinklers in Virginia. Irrigation of apples has been found not to pay except on the poorest soils, but peach irrigation seems generally to pay off in larger yields and larger fruit. In the severe drought year of 1956, peaches from irrigated orchards brought $3.25 per bu., while unirrigated peaches sold for $1.75 per bu. Along the eastern seaboard, excessive tree wetting from overhead irrigation has been known to cause brown rot and bacterial leaf spot of peaches.

426. EDWARDS, J. R., MURLEY, W. R., and WHISENHUNT, M. R. Irrigation and management systems as related to pasture production and land utilization. (Abs.) Assoc. South. Agr. Workers, Proc. 53:102-103. 1956. 4 C32

A study of the 1955 grazing season, Mountain Research Station, Waynesville, N. C. Pasture production was measured in terms of cow days per acre. Irrigated pastures yielded 31 percent more standard cow days per acre than unirrigated pastures.

427. ELEAZER, J. M. Even in 'Rainfall Belt' biggest untouched potential is irrigation. South. Livestock J. 14(2):34,66. Aug.1954. 43.8 F66A

Supplementary irrigation can do more to reduce risks and costs per unit of output than any other farm practice. South Carolina can normally expect nearly six droughts of two weeks or longer each year. Irrigation has many times saved the corn and peach crop in particular. Excellent yield increases have also been obtained with tobacco and pasture.

428. ELEAZER, J. M. Irrigation in the Southeast. Mkt. Growers J. 48:12,26. Nov.1954. 6 M34
Cites examples of gains from irrigation at various experiment stations: At Clemson, S. C., in 1953, irrigated fall tomatoes yielded 102.8 bu. of No. 1 grade, as against 8 bu. for unirrigated plots – a marketable yield of 26.5 percent as against 3.5 percent out of total yields of 386 and 230 bu. At the Alabama station an average increase in production of 18 different vegetables over 14 years of irrigation has been 38 percent: Corn from 38 to 90 bu. per acre; snap beans from minus 17 percent to 350 percent. Irrigated pastures increased cow days of grazing from 41 percent to 55 percent, and increased milk production from 45 percent to 50 percent. At the Georgia station in 1952, irrigation increased the yield of seed cotton from 642 lb. per acre to 2,534 lb. per acre.

429. ELEAZER, J. M. Water when you want it. South. Planter 114(6):6,40-41. June 1953. 6 So89
In experiments at Clemson [S.C.] Agricultural College in 1951 corn irrigated just once, at tasseling time, made 72 bu. per acre, while an adjoining unirrigated field made only 16 bu. In 1952, a wetter year, irrigated plots yielded 61 bu. per acre against 27 bu. for no irrigation. Irrigated tobacco, in 1952, showed a gain of 449 lb. per acre, with an improvement in quality amounting to a market price of $.137 per pound over unirrigated tobacco. The market value of the irrigated tobacco averaged $359.87 more per acre than the unirrigated. Five acres of cotton, irrigated just twice in 1952, yielded 10,560 lb. of seed cotton, while 5 unirrigated acres yielded only 3,375 lb. In 1952 corn made 129 bu. per acre on the irrigated half of a field of which the unirrigated half yielded only 8.3 bu. per acre. Another irrigated field yielded 164.7 bu. per acre; while the unirrigated part yielded nothing. Sweetpotatoes yielded 127 bu. of No. 1 as compared to 63 bu. on unirrigated fields, for a gross increase in returns of $368 per acre.

430. ELLIOTT, J. Keys to successful irrigation. Prog. Farmer, Ga.-Ala.-Fla. Ed. 68(2):21. Feb.1953. 6 P945G
A dairy farmer in Georgia, with a 40-hp. motor and pump and 4-in. irrigation pipe, increased milk production by nearly 3/5 gal. per day per cow during the drought of 1951, by irrigating pasture. His irrigated alfalfa field yielded 2 extra cuttings the same drought year, while an unirrigated alfalfa field did not make enough growth to cut. Since then this dairy farmer has enlarged his system to use a 120-hp. diesel motor, and 6-in. pipe, and can irrigate over 250 acres of pasture.

431. ELLIS, H. M., and WILSON, T. V. Farm irrigation. N. C. State Agr. Col. Ext. C. 400,28 p. Nov. 1956. 275.29 N811
A general guide for the use of irrigation in North Carolina. Emphasis is placed on sources of water, soil-water relationships, irrigation equipment, and diagrammatic layouts of irrigation systems. Little economics is included.

432. ELLIS, H. M. For irrigation make careful plans. Farmers Fed. News 35(9):4,22-23. May 1955. 280.28 F225
In the single year of 1954 irrigated acreage in North Carolina increased from 4,000 acres of cropland to 17,850 acres. In the same year, $3,000,000 was invested by North Carolina farmers in portable revolving sprinkler-irrigation equipment alone.

433. ENNIS, L. Summary of irrigation experiments in other Southeastern States. Ala. Polytech. Inst. Agr. Ext. C. 435:19-22. Aug.1955. 275.29 AL1C
Irrigation studies at the University of Georgia, begun in 1946, showed the following results of irrigation on various vegetables: Irrigation increased yield of tomatoes an average of 8,014 lb. per acre per year; of beans, by 619 lb. per acre per year; of okra, by 3,395 lb.; of lima beans, by 110 lb.; of cucumbers, by 5,845 lb.; of early squash, by 897 lb.; of late squash, by 100 lb.; of green peppers by 11,403 lb.; of pimiento peppers, by 9,180 lb., and of sweetpotatoes by 39.7 bu. per acre per year. At the Georgia Coastal Plains Experiment Station in 1949-51, the average increase in sweetpotato yield due to irrigation was 44.1 bu. per acre per year for the early crop, and 131.7 bu. for the late crop. Irrigation of corn at Athens, Ga., 1946-53, gave an average increase of 25.5 bu. per acre per year. Also summarizes the results of cotton irrigation in Georgia and Mississippi, and of pasture irrigation studies in Virginia, Georgia, Florida, Mississippi, Tennessee, and Kentucky.

434. EUCHNER, J. Virginia farmers attempt irrigation. Commonwealth 21(12):60-61. Dec.1954. 280.8 C732
In 1951 only 19 Virginia farms were irrigated. By 1954, 325 farms had irrigation installations. One reason for the increase was the advent of light weight aluminum pipe, which made irrigation less costly and less cumbersome. Average investment in equipment in Virginia is from $75 to $150 per acre, and annual costs average $20 per acre. Tobacco and vegetables are the most commonly irrigated crops.

435. EXPERIMENT in tobacco. Irrig. Engin. & Maintenance 6:20-21. Jan.1956. 55.8 Ir722
A Virginia farmer's irrigation system more than paid for itself the first year with increased profits of $8,000. Initial outlay was $3,820.70, which covered the cost of a pond at $2,000 and equipment at $1,820.70. Figuring depreciation and cost of electric power as amounting to $89.90 per year, irrigation cost $20.85 per acre. On a farm test plot in 1953 yield was 1,313 lb. of tobacco per acre for an income of $784.40; in 1954, with irrigation the plot produced 1,765 lb. per acre, for an income of $1,340.70 per acre.

436. FERREE, R. J. Sprinklers are a must. Amer. Fruit Grower. West. Ed. 77(6):31. June 1957. 80 G85W
Almost 50 percent of South Carolina's peach acreage is irrigated. Production per tree has been increased as much as 50 percent with irrigation, and net profit has increased by 40 to 50 percent.

437. FIELDHOUSE, D. J. Vegetable irrigation in 1954. Del. Bd. Agr. B. 44(5):16-21. 1954. 2 D37B
Potato yields in 1954 increased from 273.4 to 436.3 bu. per acre with irrigation. Five different levels of irrigation of tomatoes gave yield increases with each increase in amount of irrigation. No irrigation resulted in yields of 13 tons per acre, very light irrigation gave 13.6 tons, medium irrigation gave 18.5 tons, heavy irrigation gave 22.9 tons, and heavy irrigation during harvest gave only 20.2 tons per acre. Irrigation of lima beans increased yields from 1,988 lb. per acre to 3,569 lb. per acre.

438. FOREMAN, W. J., and RUSSELL, J. R. Should I plan to irrigate in Georgia? Ga. Expt. Sta. Mimeo. Ser. (n.s.)11,40 p. Ref. July 1955. 100 G293M
An analysis of costs and returns of 12 Georgia farms in 1954. All employed rotary-sprinkler distribution systems purchased primarily for the purpose of irrigating a single crop. Data presented are farmers' estimates of costs and the comparative yields or returns. An appendix contains additional irrigation experiences of 6 farmers. Estimated costs per acre-inch ranged from $2.68 to $20.52. It is estimated that the tobacco yield without irrigation ranges from 1,100 to 1,200 lb. per acre; with irrigation 1,400 to 1,600 lb.

439. FRANK, S. Irrigation brightens Dixie's future. Nation's Business 43(2):44,46,48-49,80-81. Feb.1955. 286.8 N212
Less than 3 percent of the tilled land in the United States is irrigated, yet that 3 percent produces 25 percent of the country's agricultural product. Most of the irrigated land is in the West, but irrigated acreage is increasing rapidly in the Southeast. In 1954 drought caused a $120,000,000 loss to farmers in South Carolina alone. Official records of the past 50 years show that in spite of the South's average annual rainfall of 50 in., the Southern States suffer about 6 crop-retarding droughts each year. Irrigation interest was first aroused among Southern farmers by experiments at the South Carolina Agricultural College at Clemson, starting in 1946. Tests started that year and continued since, have shown the following results: Irrigated cotton brought $320 per acre, compared to $80 per acre for unirrigated cotton; irrigated corn yielded 110.6 bu. per acre, compared to 8.3 bu. for unirrigated

corn; tobacco production was increased by 498.7 lb. per acre. Also discusses Senator Eastland's bill to make Government loans to farmers for irrigation equipment in the Southern and Eastern States.

440. FRY, B. O., and BAILEY, J. E. Effect of irrigation on the yield of vegetables in middle and north Georgia. Ga. Agr. Expt. Sta. C. (n.s.)1,15 p. Ref. Oct.1954. 100 G293Ci
The annual effect of irrigation on yield of vegetables at Experiment, Ga., shows that irrigated snap beans yielded 4,978 lb. per acre; nonirrigated, 3,423. Irrigated sweet corn yielded 9,522 lb. per acre; nonirrigated, 7,015. Irrigated sweetpotatoes yielded 17,308 lb. per acre; nonirrigated, 16,130. Irrigated lima beans yielded 5,902 lb. per acre; nonirrigated 5,801. Other tables, including irrigation results at Blairsville, Ga., of yield in pounds per acre of peppers, cabbage, broccoli, and lima beans, are presented. The authors conclude that if supplementary irrigation is not intelligently used, it is easily possible to decrease the yields of many vegetable crops.

441. GAINES, J. G. Irrigating tobacco. Irrig. Engin. & Maintenance 4(11):15,30. Nov.1954. 55.8 Ir722
Frequent light applications of irrigation water to tobacco at Tifton, Ga., were more beneficial than heavier, less frequent waterings. During the middle of the growing season about 1 in. of water from rainfall or irrigation is required each week. This requirement can be reduced to about 3/4 in. per week just prior to harvest after the leaf tips have filled out.

442. GAINES, J. G. Irrigation of flue-cured tobacco. Ga. Expt. Sta. Res. News 5:2. Jan.1955. 100 G29R
A table of results of research at the Georgia Coastal Plains Experiment Station, 1951-54, gives yield in pounds per acre, grade index and acre index for unirrigated and 2 irrigation treatments. The 4-year average yields were 1,240 lb. per acre unirrigated, and 1,326 and 1,510 lb. irrigated.

443. GREENSHIELDS, E. L. Irrigation in humid areas. I-II. Va. U. News Let. 32(17):1; (18):1. June 1-15. 1956. 280.9 V815
Discusses the general situation of irrigation in humid areas with special reference to Virginia. A pretest survey in preparation for the joint U. S. Bureau of the Census-U. S. Department of Agriculture, Agricultural Research Service survey on humid-area irrigation showed an average cost of $7,400 per farm for irrigation installation. The cost ranged from $2,600 to nearly $12,000. Investment cost per acre averaged $194. Total operating cost of irrigating per acre ranged from $4.76 to $36.51. The study shows also that income above costs for dairy-pasture irrigation in Tennessee averaged $62 per acre. In South Carolina irrigated hybrid corn over a 4-year period averaged 109 bu. per acre; nonirrigated, 76 bu. In Georgia vegetable-yield increases from irrigation ranged from 7 percent for sweetpotatoes to 54 percent for Irish potatoes. Farmer estimates of yield increases due to irrigation ranged from 14 percent for squash to 300 percent for watermelons.

444. HAMMOND, L. C. Can irrigation lessen citrus fruit drop? Citrus Indus. 37(7):8,18. July 1956. 80 C49
Results of study of Hamlin oranges at the College of Agriculture, Gainesville, Fla., 1955. These results were not conclusive but indications are that irrigation does reduce fruit drop. On May 4 the percent of fruit dropped was 14 on the irrigated and 33 on the unirrigated. On May 18 the percentages were 62 on the irrigated and 92 on the unirrigated.

445. HAWKINS, R. H., and PEELE, T. C. Irrigation of cultivated and forage crops on Lakeland sand. (Abs.) Assoc. South. Agr. Workers. Proc. 52:195. 1955. 4 C82
Controlled experiments reported on from Clemson Agricultural College on irrigated and replicate nonirrigated plots. Results of production increases with irrigation over nonirrigated crops are given: Four years' production averaged more than 3 times as much corn, about 75 percent more seed cotton and about 40 percent more flue-cured tobacco. Two years with sweetpotatoes averaged more than 2 1/2 times as much; 1954 production averaged more than 2 1/2 times as much alfalfa hay, more than 6 times as much Coastal Bermuda hay, and nearly 19 times as much common Bermuda hay.

446. HODGES, E. M., JONES, D. W., and KIRK, W. G. Irrigation not proven, but does produce added beef. Fla. Cattleman 15(4):20-21. Jan.1951. 43.8 F66
In experiments at the Range Cattle Experiment Station at Ona, Fla., a 4-acre plot was seeded and fertilized in October 1949. In January, 1950, irrigation was started and continued at the rate of 1/2 in. per week until March, when the watering was increased to 1 in. per week and continued until May. Eight head of cattle were grazed on the 4 acres until September. Total beef gain on the pasture was 1,970 lb. or 492 lb. per acre, and a weight increase of 246 lb. per animal. A similarly seeded and fertilized pasture, unirrigated, yielded only 70 lb. of beef per acre.

447. HOLMAN, R. L. Irrigation cancelled out the drought. Farm Impl. News 77(14):20-21,40. July 25, 1956. 58.8 F22
Irrigation systems in Florida planned for farm use by a farm equipment company have proved to be very successful. Tobacco farmers have increased their yields from an average of 1,300 lb. per acre to over 2,000 lb. with irrigation. In 1955 many growers were able to pay for their systems in one year. One dealer's success has been largely due to careful engineering and instruction in use along with a followup program on each system.

448. HORSFALL, F. Orchard irrigation study in central Virginia. Va. Fruit 42(2):77-79. Feb.1954. 81 V81B
Results of a demonstration of apple irrigation in 1953, in which the Virginia Polytechnic Institute cooperated, "materially weaken the case for irrigation on the type of site here described." Three test plots were designated. From June 8 to Aug. 30 Plot A received 1 application per week of 1 1/2 in. of water, Plot B received a 2-in. application every 2 weeks, and Plot C received no supplemental irrigation. Although 1953 was an extremely dry year, the supplemental water on Plots A and B had no appreciable beneficial effect on the apple crop. Of 1,368 apples evaluated from Plot A, 14.4 percent were of maximum size — 3 in. and up; of 1,510 apples from Plot B, 12 percent were of maximum size; and of 1,401 apples from unirrigated Plot C, 14.6 percent were of maximum size. However, irrigation did seem to have some effect on quality, as the pack of Fancy-grade fruit from the 3 plots was 35 percent from Plot A, 24 percent from Plot B, and only 17 percent from unirrigated Plot C.

449. HOWARD, R. H. Effect of irrigation upon costs, yields, and net returns. (Abs.) In Johns-Manville Corporation. Supplemental irrigation, p. Fla. 1-3. New York, 1951. 55 J62
Comparison of yields, costs, and returns for irrigated and nonirrigated grapefruit groves in Florida is given. The cost of irrigation averaged $5.68 per acre, bringing the total cost of production on the irrigated groves to $111.74 per acre, compared to $82.31 per acre for the nonirrigated. (Labor and fertilizer costs increased also with irrigation.) The irrigated acres produced 180 boxes of fruit per acre, compared with 119 boxes for the unirrigated groves. The irrigated fruit brought $.87 per box, compared to only $.72 for the unirrigated fruit. Total returns for the irrigated fruit were $157.22 per acre, and for the unirrigated fruit, $85.16. The net profit was $45.48 per acre from the irrigated groves, and only $2.85 for the unirrigated.

450. HOWELL, M. Portable irrigation on the ridge. Fla. State Hort. Soc. Proc. 63:26-29. 1950,pub.1951. 81 F66
A report in general terms by a citrus grower in the ridge section of Florida. Many suggestions and generalizations are given on portable irrigation systems.
Also in Fla. Grower 58(12):7,30. Dec.1950. 80 F6622

451. HUME, H. H. Irrigation. In his Citrus fruits. chap. 23. New York,Macmillan,1957. 93.33 H88C
Citrus requires adequate moisture either in the form of rain or irrigation. Generally the amount needed is from 35 to 45 in. annually. Florida generally has water for irrigation available wherever needed. This water is from surface sources such as lakes, rivers, and streams, or from wells, either shallow or deep. Many of the deep wells are artesian or may require some pumping. The water is distributed by flooding in furrows or checks or by means of sprinklers. Drainage is often necessary along with the irrigation to prevent alkali accumulation.

452. HUSTON, W. E. Irrigating Georgia crops. Ga. Agr. Col. Ext. B. 597,20 p. Jan.1957. 275.29 G29B
A general guide of the necessary considerations for the use of irrigation in Georgia. Emphasis is on sources of water, frequency of use, soil and water relationships, crops usually irrigated, and guides for irrigating each crop. It is pointed out that irrigation is most profitable on high-value crops but can be used successfully even on pasture or forage.

453. HUSTON, W. E. Irrigation in Georgia. Irrig. Engin. & Maintenance 5(6):18-19,37. June 1955. 55.8 Ir722
Irrigation is increasing rapidly in Georgia as shown by the fact that 35 farmers used irrigation in 1945 and 792 farmers used it in 1954. The largest acreage irrigated was pasture, followed by tobacco and truck crops. An average increase of $300 per acre has been obtained with irrigation of tobacco. Vegetable returns have been increased about 50 percent of which about half is yield increase and half quality gain. Cotton irrigation has been tried only on a small acreage but has been very successful. Yields were increased from 1/2 bale to 1 bale per acre with 1 or 2 irrigations.

454. IRRIGATION of field crops; panel discussion. Md. Agr. Soc.-Md. Farm Bur. Rpt. 39:231-234. 1954. 4 M366
A discussion of points to consider in investing in irrigation systems, factors that determine the cost, and results obtained with irrigation by members of the panel. A tobacco grower estimates average yield at 1,000 lb. per acre as compared with average yield of 800 lb. per acre in southern Maryland. Use on apple orchard, pasture, and alfalfa is mentioned. Irrigated corn yielded less for another member.

455. JAMISON, F. S. Irrigation of vegetables in Florida. Soil Sci. Soc. Fla. Proc. 15:173-175. 1955. 56.9 So32
In sprinkler-irrigation experiments, at the Florida Agricultural Experiment Station, 14 crops of 6 vegetables were grown over a 6-year period. All but 3 of the crops showed a very definite increased yield with irrigation. In the dry year of 1953 unirrigated corn produced 10,708 ears per acre, weighing 4,009 lb. With frequent irrigation (1/2 in. every 6 days) the yield was 28,344 ears per acre, weighing 13,086 lb. Green beans increased from 24 bu. per acre to 291 bu. per acre with frequent irrigation. Cucumbers with no irrigation yielded 283 bu. per acre, 40 percent of which were No. 1 grade. With frequent irrigation, the yield was 437 bu. per acre, 55 percent being No. 1 grade. Unirrigated cabbage was heavily infested with aphids, while a heavily irrigated adjoining cabbage plot had no aphid infestation.

456. JANES, B. E. The effect of irrigation, nitrogen, nitrogen level and season on the composition of cabbage. Plant Physiol. 25:441-452. Ref. July 1950. 450 P692
Cabbage grown at Gainseville, Fla., with 3 levels of irrigation in the winter of 1947-48 showed an increase in the April harvest because of a dry spring, but there was no increase in the January harvest. Frequent irrigation gave an average weight per head of 2.7 lb. in the April harvest as compared to the average weight of 1.5 lb. where unirrigated. Medium-irrigation plots averaged 2.5 lb. per head, and occasional irrigation 1.8 lb.

457. JETER, F. H. Irrigation paid on tobacco. South. Planter 116(3):8,63. Mar.1955. 6 So89
Tobacco farmers in North Carolina find that 1 acre-inch of water per week means increased yields valued up to $600 an acre. In 1 county an irrigated tobacco field realized an average of $1,004 per acre, while an adjoining unirrigated field averaged $640 an acre.

458. JETER, F. H. Rain as predicted. South. Planter 114(5):12,38. May 1953. 6 So89
The Tobacco Branch Experiment Station at Oxford, N. C., reports a 53-percent increase in value of tobacco yields per acre from irrigation, and a money value of $350 an acre over unirrigated tobacco, with the total cost of irrigation averaging $17 per acre. One tobacco farmer made 2,388 lb. per acre on an irrigated acre, compared to only 1,712 lb. on an unirrigated acre. The irrigated tobacco sold for $.617 per pound compared to $.47 per pound for unirrigated. Deducting all expenses his net profit was $1,220.90 per acre on irrigated tobacco compared with $600.89 on unirrigated. Other crops reported: Hay — up from 2.5 tons per acre unirrigated to 6 tons irrigated; corn — up from 37 bu. to 189.9 bu.; cotton — up from 454 lb. of lint to 1,300 lb.; potatoes — up from 162 bu. to 400 bu.

459. JONES, D. W., HODGES, E. M., and KIRK, W. G. Irrigated clover brought extra weight at Ona. Fla. Cattleman 16(3):20,43. Dec.1951. 43.8 F66
At the Range Cattle Experiment Station at Ona, Fla., tests were conducted, 1950-51, to determine the effect of irrigation on weight gain of beef cattle. Between Nov. 1950 and June 1951, 14 in. of water was applied, and from June 6 until Apr. 24, 1951, 2-year-old steers were grazed. The steers made a gain of 460 lb. per acre. Yearling heifers were grazed from May to October, and made gains of 590 lb. per acre, giving a total beef gain per acre of 1,050 lb. Cattle days were 584, with an average daily gain per head of 1.79 lb. from Jan. 6 to Oct. 27.
Abs. in Assoc. South. Agr. Workers. Proc. 50:200-201. 1953. 4 C82

460. JONES, J. N. Timing irrigation to critical periods of selected crops. (Abs.) Assoc. South. Agr. Workers. Proc. 53:36-37. 1956. 4 C82
Maximum need for irrigation of corn occurs during the vegetative growth period from about 10 days prior to tasseling through the milk stage. The peak period for tobacco is from knee-high through the bloom stage. Maximum daily rate of evapotranspiration in Virginia at this time is 0.29 in. per day. Average for both crops is about 0.13 to 0.18 in. per day.

461. JUDKINS, W. P. Shall we irrigate? East Fruit Grower 17(5):6-8. July 1954. 80 Ea73
A general discussion of the irrigation of fruit orchards, mainly in Virginia. Recommends sprinkler irrigation as being more satisfactory than furrow irrigation, because there is as much as 50 percent less water loss in sprinkler irrigation on Eastern soils. The labor requirements for a portable sprinkler system will be greater than for a furrow system, but the overall cost of operation will still be less than the cost of construction and maintenance of a furrow system.

462. KEENER, R. L., and HOLMES, R. T. Low pressure sprinkler irrigation for vegetables. In Johns-Manville Corporation. Supplemental irrigation, p. Ga. 1-6. New York,1951. 55 J62
In experiments at the Georgia College of Agriculture with overhead sprinkler irrigation of vegetables, the following results were obtained: On a 3.1-acre field of tomatoes, corn, greens, beans, collards, and turnips, a $484.00 sprinkler system was installed ($156.13 per acre). The annual costs for the system (operation, depreciation, labor, and repairs) amounted to $69.18. The resultant crop had a commercial value of $704.23, a net profit of $635.05, or $204.85 per acre, compared to a profit of $32.64 per acre from a similar unirrigated field. A 4.5-acre field of kale, spinach, mustard greens, turnips, and collards, after irrigation produced a crop valued at $736.33, compared to a similar unirrigated field whose total crop value was $73.63. Operating costs of the irrigated field (operation, depreciation, maintenance, repairs, and labor) amounted to $74.67 for the 4.5 acres, leaving a net profit of $661.66 from the irrigated plots, or $588.03 more than was received from the unirrigated field — a total profit of $130.66 per acre.

463. KING, F. P. Tobacco irrigation: Will it pay? Prog. Farmer, Ga.-Ala.-Fla. Ed. 72(4):34,199. Apr.1957. 6 P945G
Irrigation of tobacco at the Georgia Coastal Plain Experiment Station at Tifton from 1949 to 1956 has averaged 340.6-lb. increase in yield over the 8 years. The yield increase was from 1,495 to 1,835 lb. Price increase was from $46.88 to $56.04 for a gross increase of $330 per acre. A Farmers-Home-Administration study of costs of 23 farmers in 1955 showed an average investment of $5,821 per farm or $617 per acre. Annual costs were $852.51 per farm or $111.70 per acre for an average of slightly over 5 applications per acre. Income per acre in 1955 was $1,072 compared to the average $865 on the same farms from 1951 to 1954 without irrigation. This leaves a net profit of $95 per acre. If the Tifton yield

figures are used the profit is $218 per acre. Most farmers can probably expect something between these figures for the Georgia Coastal Plain.

464. KING, J. C. These county agents really sell irrigation. Agr. Leaders' Digest 37(4):10-11. Apr.1956. 275.28 Am3
Demonstrations conducted by Marion County, S. C., county agents in 1955 with irrigated and nonirrigated tobacco crops produced the following: Average yield 2,019 lb. per acre, average value per acre $1,129.42; and 1,813 lb. per acre, average value per acre $1,005.12 respectively. Results of the 1955 Marion County 3-Acre Corn Contest with irrigated and nonirrigated crops: Average yield 130.2 bu. per acre, and 82.5 bu. per acre; aver-value per acre $169.35 and $107.25; average cost of production per acre $84.11 and $67.57; average cost of production per bu. $.646 and $.819 respectively.

465. KING, W. A. Irrigation of annual summer and winter pasture crops. (Abs.) Assoc. South. Agr. Workers. Proc. 53:107. 1956. 4 C82
Resumé of an experiment during 1954-55 at South Carolina Agricultural Experiment Station, Clemson, giving results from nonirrigated and irrigated plots, respectively. Average daily milk production: Pearl millet, 36.8 and 41.0 lb.; Abruzzi rye, 35.3 and 34.7 lb.; sweet Sudangrass 40.0 and 42.3 lb. TDN per acre: Pearl millet, 666 and 2,272 lb.; Abruzzi rye, 1,007 and 2,128 lb.; sweet Sudangrass, 1,063 and 1,345 lb. Net return per acre for irrigation was $41.76 for Pearl millet, $30.72 for Abruzzi rye, and $1.65 for sweet Sudangrass, which suffered blight damage.

466. KOO, R. C. J., and SITES, J. W. Results of research and response of citrus to supplemental irrigation. Soil Sci. Soc. Fla. Proc. 15:180-190. 1955. 56.9 So32
Irrigation of oranges at the Florida Agricultural Experiment Station in 1954-55 produced the following increases in yields. Pineapple oranges: 74 unirrigated trees yielded 5.27 boxes of fruit per tree, or 390 boxes per plot; 74 irrigated trees produced 6.11 boxes per tree, or 452 boxes per plot. Valencia oranges: 45 unirrigated trees yielded 3.58 boxes per tree, or 161.25 boxes per plot; 45 irrigated trees produced 4.78 boxes per tree, or 215 boxes per plot. Irrigation had no appreciable effect on internal quality of the fruit.

467. KOO, R. C. J. Weather conditions, irrigation, practices, and valencia orange production. Citrus Mag. 19(11):8-10,16-17. July 1957. 80 C498
Valencia oranges in Florida in 1955 averaged 5.42 boxes per tree where unirrigated and 6.14 boxes where irrigated. The gain from irrigation was .72 boxes per tree. The amount applied varied from .5 to 15 in. and averaged about 3 in. In general two extended dry periods occurred during February-March and again in April-May. Each was nearly 30 days in length.

468. LAND, W. B., and CARREKER, J. R. Results of evapotranspiration and root distribution studies. Agr. Engin. 34:319-322. Ref. May 1953. 58.8 Ag83
Evapotranspiration rates at the Georgia Experiment Station for tomatoes, pole beans, corn, and cotton. In 1952 the average rate for tomatoes was .187 in. per day; .185 in. per day for pole beans; .196 for cotton; and .22 for corn. Yields of tomatoes increased from 6,452 lb. per acre to 18,915 lb.; from 541 to 5,183 lb. per acre for pole beans; from 742 to 2,534 lb. of seed and lint per acre for cotton; and from 10.6 to 70.1 bu. per acre for corn. Rooting depths were about 18 in. for corn and slightly deeper for cotton.

469. LAW, W. P., BEALE, O. W., and DUNKELBERG, G. H. Corn irrigation. In Johns-Manville Corporation. Supplemental irrigation, p. S. C. 2-3. New York,1951. 55 J62
Experiments at the South Carolina Agricultural Experiment Station in 1949. Rainfall during the season was 31.5 in. Irrigated plots received a total of 6.5 in. of additional water, applied whenever half of the available water at the 8-in. depth was used. The irrigated plots yielded an average of 85 bu. of corn per acre, compared to 65 bu. per acre on the unirrigated plots. The lodging in the irrigated plots amounted to 45 percent, compared to only 32 percent in the unirrigated plots. This was caused by the fact that the irrigated stalks were taller, and the ears of corn were larger and heavier.

470. LAW, W. P. Effects of irrigation on yield and fiber quality. Cotton Gin & Oil Mill Press 55(17):59. Aug.14,1954. 304.8 C822
Experiments at the South Carolina Agricultural Experiment Station with irrigation of cotton showed the following results in pounds of seed cotton per acre: No irrigation, 1,560 lb.; 1 irrigation, 1,860; 2 irrigations, 2,215; 3 irrigations, 2,150. Staple length without irrigation was 31/32 in.; with 1 irrigation, 1 in.; with 2 irrigations, 1 1/32 in.; and with 3 irrigations, 1 1/32 in. Percentage of fat and oil in cotton seed was 23.8 with no irrigation; 25.5 with 1 irrigation; 25.79 with 2 irrigations; and 27.02 with 3 irrigations.
Also in Acco Press 34(10):12-13. Oct.1954. 6 Ac2

471. LAWRENCE, L., Summary of irrigation experiments in other Southeastern States. Ala. Polytech. Inst. Agr. Ext. C. 485:19-22. Aug.1955. 275.29 AL1C
Cites results of studies at Georgia University of the irrigation of 10 vegetable crops as follows (increase per acre): Tomatoes - 8,014 lb.; beans - 3,619 lb.; okra - 3,394 lb.; lima beans - 110 lb.; cucumbers - 5,845 lb.; squash (early) - 897 lb.; squash (late) - 1,000 lb.; green peppers - 11,403; pimiento - 9,180 lb.; sweetpotatoes - 39.7 bu. Also cites following reports from various States: Average corn-yield increase with irrigation in Mississippi ranged from 2.4 bu. per acre in a wet year to 36.8 in a dry year. Corn-yield increase at Athens, Ga., averaged 255 bu. per year with irrigation. Seed-cotton yield at Clemson, S. C., increased by 655 lb. per acre after irrigation. At Watkinsville, Ga., 1949-53, seed-cotton-yield increase averaged 687 lb. per year. At Athens, Ga., irrigated pastures increased grazing days per acre from 280 to 372, increased animal weight gain in pounds per acre from 315 to 395, and increased herbage yield from 3.6 tons per acre to 3.91.

472. LIDDELL, W. J. Effective methods of irrigating Southeastern pastures. Irrig. Engin. & Maintenance 3:16-17,26-28. Apr.1953. 55.8 Ir722
Methods of irrigation of pastures are described in general. Investment costs for sprinklers are from $50 to $100 per acre, with operating costs of $1 to $2.50 per acre-inch. Pasture yields are generally nearly doubled in the Southeast.
Abs. in Assoc. South. Agr. Workers. Proc. 50:94-95. 1953. 4 C82

473. LIDDELL, W. J. Humid States farmers discover irrigation. Reclam. Era 43(2):37-40. May 1957. 156.84 R24
In the last 2 years the Farmers Home Administration program in the U. S. D. A. has made loans for the installation of irrigation systems for 120,000 acres in the 31 Eastern States. Cotton needs 16 in. of moisture in Georgia from May 28 to August 27. Cotton yields were increased from 3,257 to 3,621 lb. of seed cotton per acre.

474. LIDDELL, W. J. Preliminary results of supplemental irrigation with a portable sprinkler system. In Johns-Manville Corporation. Supplemental irrigation, p. Ga. 11-13. New York,1951. 55 J62
Studies at the University of Georgia with irrigation of pasture, field corn, and truck crops. Pasture irrigation: A 4-acre pasture and an adjacent 3-acre pasture were planted identically; rain was plentiful during June and July, and no irrigation was necessary until August, when a 3-week dry spell occurred. At the end of the second week of the drought, the 4-acre pasture was given a 2-in. application of water. This was the only difference in treatment given the 2 pastures In October, vegetation samples taken from each pasture showed that the irrigated pasture produced 3,480 lb. of dry matter per acre, compared to 2,200 lb. for the unirrigated pasture, a 58.3 percent increase from irrigation. Field corn: Two 2-in. irrigations caused a 14.2-percent increase in the yield of field corn over an unirrigated plot. Truck crops: Irrigation of lima beans caused a 55.8-percent increase in yield; of okra, a 59.9-percent increase; of squash, an 11.9-percent increase; of cucumbers, a 57.8-percent increase; and of green peppers, a 120-percent increase.

475. LUND, C. M., LAW, W. P., and BEALE, O. W. Sprinkler irrigation of field corn. S. C. Agr. Expt. Sta. B. 421,34 p. May 1955. 100 So8
In tests at the Clemson Agricultural Experiment Station, 1946-53, the 8-year average increase in corn yield due

to irrigation was 41 bu. per year. The average market value of the increase was $77.92 per acre, the average cost of irrigation was $15.30 per acre, the average labor cost for harvesting the yield increase was $.10 per bu. or $4.10, and the net return was $58.65 per acre. In 1947, the year of greatest increase, the plots were fertilized with 2,100 lb. of 4-10-6, 130 lb. of nitrogen, and 250 lb. of muriate of potash per acre. A total of 5.3 in. of supplemental water was applied (rainfall data not given), and the yield increase was 89 bu. per acre, gross increased income was $177.20 per acre, cost of irrigation was $15.60, and the net increased return was $151.70 per acre. In 1948, although irrigation increased yield by 3 bu. per acre, the increase did not pay for the irrigation, and there was a loss of $10.52 per acre on the irrigated plots. The same fertilizer treatment was applied as in 1947, with the difference that no muriate of potash was added in 1948. Other findings: Irrigation did not affect lodging; greater plant populations were possible under irrigation; greater net returns were obtained when irrigation was withheld until the boot of the tassel appeared.

Also in S. C. Agr. Res. 1(3):3. July/Sept.1954. 100 So8So; and in Farm & Ranch-South. Agr. Upper So. Ed. 84(3):15,72. Mar.1954. 6 T31

476. LUTZ, J. A., RICH, C. I., and OBENSHAIN, S. S. Penetration of top-dressed phosphate in the soil as influenced by source, rate, and time of application and by irrigation. Va. Agr. Expt. Sta. Tech. B. 125,10 p. Oct. 1956. 100 V81S

Phosphorus penetration in Groseclose silt loam increases directly with the increase in amount of phosphate added to the soil. Irrigation did not change the pattern of phosphorus penetration. Nine hundred lb. applied at one time penetrated deeper than annual applications of 150 lb. for 6 years. Light applications stay in the top 2 in. of the soil and the heavier applications may penetrate to a depth of 8 to 10 in. Generally phosphorus stays very nearly where placed in the soil.

477. LYNN, H. P. Supplemental irrigation in South Carolina. Better Crops Plant Food 40(2):15-18,43-44. Feb.1956. 6 B46

General discussion on sources of water and need for irrigation. Includes effect on yields of tobacco, corn, cotton, cantaloupes, and peppers. A summary of a study of 82 years of weather records is given. There was an average of 2.5 droughts of 14 to 30 days duration per year for the growing season. Investment costs for irrigation will generally run about $125 per acre. The average yield increase on tobacco from 1951 to 1954 was 365 lb. per acre. The average yield without irrigation was 1,182 lb. per acre. The quality was also increased as indicated by the average price of $.452 for the unirrigated and $.544 for the irrigated tobacco. Over an 8-year period at Clemson the yield of corn was increased 41 bu. with irrigation. Cotton yields with irrigation increased from 500 to 828 lb. of lint per acre. Cantaloupes in 1954 increased from 115 to 264 bu. per acre with irrigation. Pimiento peppers increased from 7,074 to 12,195 lb. per acre with irrigation.

478. MCCLOUD, D. E. Agricultural water requirements. Engin. Prog. U. Fla. 9(4):19-21. Apr.1955. 290.8 En37

The consumption of water for agricultural use in Florida accounts for almost half the total annual water use for all purposes in the State, including municipal and industrial use. Water requirements for agricultural use depend on the rate of evapotranspiration of the crops. Sufficient water must be applied to maintain evapotranspiration. On an average day following a rain, evapotranspiration accounts for a total upward movement of water from the soil into the atmosphere of 142 billion gal. per day for the State of Florida. This tremendous upward surge of water must be maintained to obtain top crop yields. Supplemental irrigation must be used to supply that amount which natural rainfall fails to provide.

479. MCCLOUD, D. E. Water requirements of field crops in Florida as influenced by climate. Soil Sci. Soc. Fla. Proc. 15:165-172. 1955. 56.9 So32

Agrohydrologic research at the Florida Agricultural Experiment Station. Crop-water-use rates were measured and an empirical formula developed for predicting them from daily mean temperature. Using daily precipitation, evapotranspiration, and a given water-storage level, agrohydrologic balance was computed. A further extension of the concept, based on long-time climatological records, provides the expected frequency and intensity of droughts.

480. MCCRANEY, R. J. A power company speaks its mind. Irrig. Engin. & Maintenance 6(2):22,27. Feb. 1956. 55.8 Ir722

The Georgia Power Company offers electrical service to irrigators on a competitive basis wherever possible. Most of its lines are single phase so that the size of motors is limited to 7.5 hp. When it can be done it is best to extend 3-phase current for best results. Rates are based on demand for the highest 30-minute period and the number of kw.-hr. used.

481. MAGNESS, J. R. Orchard irrigation in the East. N. J. State Hort. Soc. Hort. News 35:2781,2783-2784,2798. May 1954. 81 N46

Irrigation of orchards in the Potomac and Shenandoah Valleys will increase fruit yields and sizes about 30 to 50 percent in about 6 years out of 25. Increases will be 10 to 30 percent in about 8 of 25 years. In the remaining 11 years of 25 the increase is expected to be less than 10 percent. This response is with apples on soils less than 2 ft. deep. Peaches will normally show even more spectacular results. Investment costs generally run about $150 per acre and cost of irrigating is about $25 to $30 per acre per year.

482. MAGNESS, J. R. Practicability of irrigating pecan orchards in Southeastern States. Soeast. Pecan Growers Assoc. Proc. 48:23,25-26,28-29. 1955. 94.69 G29

During the period from bloom to shell hardening, lack of sufficient water will result in small pecan nuts. On the whole, however, poor nut quality and size in pecans is more apt to result from too much rather than from too little moisture. It seems questionable whether pecan crops alone will pay for irrigation equipment. It costs about $150 per acre to install an irrigation system, and $25 to $30 per acre per year to operate it. On the basis of longtime rainfall records, not oftener than once in 10 years would irrigation of pecan groves in the Southeast pay for this annual cost.

Also in Irrig. Engin. & Maintenance 5(6):16-17,35. June 1955. 55.8 Ir722

483. MARYLAND. UNIVERSITY. EXTENSION SERV. Irrigation in Maryland. Md. Agr. Col. Ext. Fact Sheet 71,4 p. July 1953. 275.29 M36Fa

A general summary of the pros and cons of irrigation, with citations of various experiences in other Eastern States. Discusses factors affecting costs, and the crops which can be most profitably irrigated. Lists sweet corn, beans, greens, broccoli, potatoes, and sweetpotatoes, as responding well to irrigation in yield and in quality.

484. MARYLAND. UNIVERSITY. EXTENSION SERV. Irrigation in Maryland. Md. U. Agr. Ext. Fact Sheet 71, rev.,4 p. June 1955. 275.29 M36Fa

Factors which determine whether irrigation will pay are: Dependable source of water, soil considerations, costs of operating, and value of crops to be irrigated.

485. MILLER, E. N. Results of 3 years of irrigation. Mountaineer Grower 24(201):15,17. Mar.1954. 80 M86

Irrigation of peaches near Romney, W. Va., has proved very successful during the years 1951-53. Not only does irrigation increase the size of the peaches, but the grades go up accordingly. As the diameter of the peaches increased from 1 3/4 to 2 to 2 1/4 in. the price received increased from $1.29 to $2.15 to $2.46 per basket. The number of peaches per basket decreased from 407 to 285 to 200 as size increased. Income per acre increased with irrigation from $225 to $585 per acre. Costs averaged between $20 and $40 so that net increase in income was $320 to $340 per acre.

486. MINER, F. Irrigation in the East. Irrig. Engin. & Maintenance 3(7):17-19. July 1953. 55.8 Ir722

Supplemental irrigation is proving to be a very profitable practice for many crops in the East. A Virginia farmer irrigating 70 acres of alfalfa found his investment cost to be $112.50 per acre and total operating costs to be about $49 per acre including fixed costs and labor. A North Carolina farmer increased his alfalfa yield from 2 to 10 tons per acre with irrigation. A Virginia tobacco farmer increased his net profit by $380 per acre with irrigation. A Virginia dairy farmer pastured 65 cows on 20 acres after using irrigation.

487. MULLEN, H. H. Growers get ABC's of good irrigation. Fla. Grower 58(12):9,14. Dec.1950. 80 F6622
An irrigation demonstration was arranged on 445 acres of Bahiagrass in Marion County, Fla. Irrigation has paid very well for beef cattle on this ranch.

488. MURLEY, W. R., WAUGH, R. K., and MOORE, J. L. The effect of supplemental irrigation on the yield of clover-grass pastures as measured by lactating dairy animals. (Abs.) Assoc. South. Agr. Workers. Proc. 50: 95-96. 1953. 4 C82
Trials conducted at the Agricultural Experiment Station, Raleigh, N. C., in 1951-52 on Ladino-clover-fescue pastures using 3 plots with and 3 plots without supplemental irrigation: Yields for the two years were 3,039 lb. of calculated TDN and 8,647 lb. of 4 percent fat-corrected milk per acre from the irrigated plot and 1,999 lb. and 6,917 lb., respectively, from the unirrigated.
During the same two seasons a second experiment was conducted at the Mountain Experiment Station, Waynesville, N. C., with various combinations of pasture crops, poorly drained soil, irrigation and no irrigation. Results are given in percentages. Irrigation costs are not given.

489. MURLEY, W. R., WAUGH, R. K., and MOORE, J. L. Half again. N. C. Agr. Expt. Sta. Prog. Rpt. 11:8-9. Summer 1952. 100 N81R
Two-year pasture-irrigation studies by the North Carolina Agricultural Experiment Station are summarized. Of 181 total grazing days, the unirrigated pasture was grazed only 107 days, the irrigated pasture 181 days. The unirrigated pasture grazed only .69 cows per acre, the irrigated pasture 1.05 cows. Cows on the irrigated pasture consumed 14,384 lb. of grain on 4.56 acre, and had no supplementary feeding. Cows on the unirrigated pasture consumed 13,628 lb. of grain on 5.38 acres, and had in addition 4,090 lb. of hay and 11,085 lb. of silage, yet the milk production of these cows was less than that of the cows on the irrigated pastures.

490. MYERS, J. M., and MARSHALL, S. P. Irrigation of permanent pasture for lactating dairy cattle. Soil Sci. Soc. Fla. Proc. 15:176-179. 1955. 56.9 So32
Studies at the Florida Agricultural Experiment Station from 1952-1955. Irrigation-water requirements averaged 20 in. per year in 1952, 1953, and 1954. The irrigated pasture for these 3 years produced 21.6 percent more TDN during the clover season, and 9.1 percent more TDN during the grass season, than the unirrigated. In 1955, a very dry year, the unirrigated pasture yielded only 32.3 percent as much clover as the irrigated. In all 4 years, grazing was started an average of 14 days earlier on the irrigated than on the unirrigated pasture, and a more uniform carrying capacity of cattle was maintained.

491. MYERS, J. M., and SKINNER, T. C. The utilization of water by agriculture in Florida. Soil & Crop Sci. Soc. Fla. Proc. 16:96-101. 1956. 56.9 So32
Estimated supplemental-irrigation-water requirement for crops in Florida are given as follows: 261,000 acre-feet per year for citrus; 232,000 for vegetables and truck; 9,000 for tobacco, 453,000 for pasture, and 87,000 for miscellaneous. In 1956, 42.8 percent of citrus land was irrigated in Florida, 85 percent of vegetable and truck land; 33.3 percent of tobacco land; and 9.2 percent of pasture.

492. MYHRE, D. L., MCCUBBIN, E. N., and VOLK, G. M. Effects of irrigation, fertilization and seeding rates on potato yields in 1955 at Hastings, Florida. Fla. State Hort. Soc. Proc. 68:233-235. 1955. 81 F66
Average yield for the entire experimental area was 283 sacks per acre, about 120 sacks above the average 1955 yield for the area. Average yield of plots seeded at the high rate (2,450 lb. per acre) was 301 sacks per acre, exceeding the yield of plots seeded at the low rate (1,470 lb.) by 36 sacks per acre, of which 92 percent were 1-A potatoes. About 10 additional sacks of seed were used for the high rate of planting. Furrow irrigation was used to obtain different water levels.

493. NETTLES, V. F., JAMISON, F. S., and JANES, B. E. Irrigation and other cultural studies with cabbage, sweet corn, snap beans, onions, tomatoes, and cucumbers. Fla. Agr. Expt. Sta. B. 495,26 p. Ref. June 1952. 100 F66S
Experiments in Florida showed the following effects of light and heavy irrigation on yield per acre of 6 vegetables: Cabbage — light irrigation .98 tons increase; heavy irrigation .15 tons decrease; sweet corn — light irrigation 616.7 lb. increase, heavy, 1,178.8 lb. increase; snap beans — light irrigation 173.2 bu. increase, heavy irrigation 206.4 bu. increase; onions — light irrigation 5,962 lb. increase, medium irrigation 14,547 lb. increase, heavy irrigation 9,710 lb. increase; tomatoes — light irrigation 24.4 bu. increase, medium irrigation 148.9 bu. increase, heavy irrigation 106.6 bu. increase; cucumbers — light irrigation 41.9 bu. increase, medium irrigation 154.3 bu. increase; heavy irrigation 111.1 bu increase.

494. NETTLES, V. F., JAMISON, F. S., and JANES, B. E. Irrigation studies with sweet corn, cabbage, and snap beans at Gainesville. In Johns-Manville Corporation. Supplemental irrigation, p. Fla. 6-11. New York,1951. 55 J62
Experiments at the Florida Agricultural Experiment Station to determine the effectiveness of irrigation in improving the yield and quality of vegetables in Florida. With sweet corn, nonirrigated plots produced 156.9 lb. per acre at the first harvest, lightly irrigated plots produced 888.5 lb., and heavily irrigated plots yielded 1,565.3 lb. per acre, or 10 times as much as the unirrigated plots. In the case of cabbage, in 1947, plots received varying amounts and types of fertilizer, and varying degrees of irrigation, with the following results: The 8-7-5 plot produced 2.28 tons per acre when not irrigated, 5.07 tons when lightly irrigated, and 5.40 tons when heavily irrigated. The 4-7-5 plot produced 2.49 tons per acre unirrigated, 5.34 tons when lightly irrigated, and 5.86 tons when heavily irrigated. A 4-7-5 plot with a side dressing of nitrogen produced 2.28, 5.31, and 6.06 tons per acre when not irrigated, when lightly irrigated, and when heavily irrigated, respectively. With snap beans in 1947 nonirrigated plots yielded 24 bu. per acre, lightly irrigated plots yielded 197.1 bu., and heavy irrigation produced a crop of 230.4 bu. per acre.

495. NEWSOME, H. The big gun boys. Irrig. Engin. & Maintenance 7(5):21,46-47. May 1957. 55.8 Ir722
Irrigation of vegetables in winter in southern Florida is very profitable. Many of the farmers are using the large sprinklers designed to cover 2.5 acres at one time. Most farmers use many wells since the water table is within 30 ft. and cost of the wells is very low.

496. NOLL, J. J. Water in the Southeast. J. Soil & Water Conserv. 7:30-34. Jan.1952. 56.8 J822
Rainfall in the Southeast varies from a low of 32 in. in parts of Virginia to 84 in. in the mountains of North Carolina. The average is about 50 in. and average runoff is from 10 to 40 in. annually. In 1950 an estimated 14 billion gal. of water were used daily in the 9 States for municipal, industrial, rural, and irrigation purposes. Four hundred million acre-feet are used annually for hydroelectric power.

497. PARKER, M. M. Irrigating white potatoes. South. Planter 115(3):66,70-71. Mar.1954. 6 So89
Irrigation of 10 varieties of potatoes in eastern Virginia resulted in an average yield increase of 41 percent in 1953. Soil moisture for potatoes should be kept as uniform as possible for constant rate of growth. Irrigation not only increases yields, but fewer small potatoes are produced, quality is improved, fertilizer is used efficiently, sizes are more uniform, and more intensive production methods are possible.

498. PATTON, C. R. Properly installed irrigation systems profitable today as in ancient civilizations. Farmers Fed. News 34(9):5,13,17. May 1954. 280.28 F225
In 1953 the FCIC paid 146 farmers of Buncombe County, N. C., for losses on their tobacco crop due to drought,

while in the same year, on farms where tobacco was irrigated, yields were higher and profits exceeded those of normal years. Supplemental irrigation of a 10-acre field would require 5 acre-feet of water, or the entire contents of a 2-acre pond 8 ft. deep. Water supply is the most important consideration in any irrigation system.

499. PETTIS, A. M. Electric irrigation forges ahead in Florida. Fla. Grower 60(3):15,32. Mar.1952. 80 F6622
Many Florida growers are turning to electricity as the source of power for irrigation pumps. Installation costs are about equal to gasoline motors and operating costs are much cheaper.

500. PETTIS, A. M. Power for irrigation in Florida. Rur. Electrif. 10(9):66. June 1952. 335.8 N21
In Florida the principal complaints against gasoline engines as pumping units are the perpetual care necessary in their operation, and the high maintenance and repair bills. Diesel engines present not only the problem of excessive installation costs, but also the scarcity of trained diesel mechanics when the system breaks down. The initial cost of an electric engine is about equal to that of a gasoline engine, and a great deal less than that of a diesel. Operating costs of an electric pump average about $9.00 per hp. per year. Data collected by REA co-ops in Florida show that in cases where the system is used more than 200 hours per year, electric power will be the cheapest pumping equipment. With systems used less than 100 hours per year, gas or diesel engines may be more economical.

501. PRESTON, J. B. Irrigation of flue-cured tobacco in Georgia. Atlantic Coast Line Agr. & Livestock Topics 7(4):1,4. Apr.1955. 6 At63
Discusses certain basic principles obtained from tobacco-irrigation experiments at the Coastal Plain Experiment Station, Tifton, Ga. Net increases from irrigated tobacco have varied from $14 per acre in 1949 to more than $800 in 1954. The average increase has been about $283 per acre. Over a period of years growers who irrigate may expect an additional average profit of from $200 to $300 per acre per year.

502. QUACKENBUSH, T. H. Humid area irrigation; growth — problems — benefits. Washington,U. S. Soil Conserv. Serv.,1954. 8 p. 1.96 Ad2Q2
Talk given at 9th Annual Meeting of the Soil Conservation Society of America, Jacksonville, Fla., Nov.17, 1954.
Tests at Georgia Agricultural Experiment Station in 1952 showed nonirrigated tomatoes averaged 6,452 lb. per acre; irrigated tomatoes averaged 18,915 lb. Irrigated seed cotton in a Georgia experiment produced 2,534 lb. per acre while nonirrigated yielded 742 lb. Twenty-nine irrigated tobacco farms in North Carolina in 1952 had an average increase of gross income of $210 per acre; average net increase in profit of $161.48 per acre. In 1953 North Carolina State College reported these results on 48 irrigated tobacco farms: Average gross increase in income per acre was $402; average net increase in profit per acre was $346.18.
Also in Plant Food J. 8(4):2-3,16-17. Oct./Dec.1954. 57.8 P692

503. QUACKENBUSH, T. H. Irrigation invades the East. Land Impr. 2(2):7-9,29. Feb.1955. 282.8 L224
In Georgia in 1952 nonirrigated tomatoes averaged 6,452 lb. per acre, compared to 18,915 lb. for irrigated tomatoes. In Tennessee irrigated pastures produced 54 percent more milk per acre, averaging a net increase of $115.54 per acre. In North Carolina in 1952, irrigation of 29 tobacco farms gave an average gross increase in income of $210 per acre, or an average net increase in profit of $161.48 per acre. In a 1953 study of 48 irrigated farms in North Carolina, the average net increase in profit due to irrigation was $346.18 per acre of tobacco.

504. RACE, A. T. Florida turns to sprinkler irrigation. Amer. Fruit Grower 71(6):13,23-25. June 1951. 80 G85
Citrus growers in Florida began switching from flood irrigation to sprinkler irrigation after World War I. Until World War II galvanized steel pipe was used, but the shortage of steel during that War drove the growers to the use of aluminum pipe. It was found that the aluminum pipe required only 50 percent as many man-hours as had the steel pipe, and that operating costs were reduced from 50 percent on large acreages to 75 percent on smaller acreages.

505. RATLEDGE, W. R. Triple purpose ditches. Soil Conserv. 21:230-232. May 1956. 1.6 So3S
A Delaware blueberry farmer uses the same ditches for drainage, surface irrigation, and sprinkler irrigation. Holding water in the ditches helps control the water table under the blueberries.

506. REPORT on irrigation demonstration, Monroe, Georgia, summer, 1943. In Johns-Manville Corporation. Supplemental irrigation, p. Ga. 7-8. New York,1951. 55 J62
At a total labor cost of $10.50 (28 man-hours at $3.00 per day) plus a total electric cost of $1.44 (48 kw.-hr. at $.03 per kw.-hr.) 5 irrigations were given to a field of sweetpotatoes, with the following results: Field-run potatoes, 154.35 bu. per acre, as compared to 88.2 bu. per acre from an unirrigated check plot; No. 1 grade potatoes, 85.7 bu. per acre, compared to 24.5 bu. per acre from the check plot: No.2 potatoes, 68 bu. per acre from the irrigated plot, 63.7 bu. from the check plot.

507. REYNOLDS, C. W. Irrigation of snap beans, cucumbers, and sweet corn. Md. Agr. Soc.-Md. Farm Bur. Rpt. 39:180-183. 1954. 4 M366
Yields at 3 levels of irrigation and no irrigation, during 1954 from studies carried out by the Department of Horticulture of the University of Maryland. Experiment at Salisbury with cucumbers resulted in total yields of 503 to 593 bu. per acre irrigated as compared with 250 bu. per acre, not irrigated. Snap-bean experiments at Salisbury resulted in yields ranging from 2.27 to 3.52 tons per acre as against 1.68 tons, with no irrigation; at College Park, yields were 6.51 and 7.41 tons per acre as against 3.83 and 5.29 for summer and fall crops of snap beans irrigated and nonirrigated, respectively. Sweet corn not mentioned.
Also in Del. Bd. Agr. B. 44(5):22-23. 1954. 2 D37B; and in Canning Trade 78(40):7,18. Apr.23,1956. 286.83 T67

508. REYNOLDS, C. W. Irrigation of truck crops. Veg. Growers Assoc. Amer. Annu. Rpt. 1955:161-164. 81 V52
Cites examples of increased yield of various crops in other States, and summarizes experiences in Maryland. The number of irrigated acres in Maryland grew from 700 in 1949 to 12,000 in 1954 to 20,000 in 1955. The crops most commonly irrigated in Maryland are snap beans, sweet corn, tomatoes, cucumbers, and broccoli. Irrigation of cucumbers caused an increase in yield of 108 percent in 1954-55, and raised the marketable percentage from 55 to 77. The cucumbers after irrigation were more uniform in shape and had a darker color. Snap beans yielded an average of 75 percent more after irrigation, with a smaller percentage of malformed pods, and an increase in the number of large pods.

509. ROGERS, B. L., and WRIGHT, J. E. Experience in irrigation of peaches in 1955. Md. Agr. Soc.-Md. Farm Bur. Rpt. 40:149-152. 1955,pub.1956. 4 M366
Controlled experiment in 2 commercial orchards to determine actual size increase in Elberta and Sunhigh peaches as influenced by irrigation. Each orchard had a nonirrigated plot. Sunhigh, not in sod, received water twice and resulted in fruit volume of 120 cc. with 78 cc. for the nonirrigated fruit, a size increase of over 40 percent; Elberta, in sod, received water 4 times and resulted in fruit volume of 127 cc. as compared with 95 cc. for the nonirrigated fruit, a size increase of about 25 percent.
Also in Md. State Hort. Soc. Proc. 58:31-34. 1956. 81 M36; and in slightly different form in Del. Bd. Agr. B. 45(5):25-28. 1955. 2 D37B

510. SAVAGE, Z. Does grove irrigation pay? Yes and no. Citrus Indus. 33(9):4,13-15. Sept.1952. 80 C49
Irrigation of citrus in Florida needs to be observed and tested carefully in each grove to determine if the added yield will bring in enough income to cover the added costs. The problems of when to irrigate, how much, proper fertilizer use with irrigation, varieties, spacing, cover crops, etc. are still largely unanswered with citrus irrigation.

511. SAVAGE, Z. Does irrigation pay on your grove? Citrus Indus. 34(12):9. Dec.1953. 80 C49
Evidence gathered from grove records over 21 seasons by the Florida Agricultural Experiment Station and the Florida Extension Service, indicates that irrigation of citrus does not always pay in Florida. At an average cost of $15.25 per acre for each 2-in. irrigation, it was found, over a period of 5 years from 1947-52, that in order to pay for 1 irrigation, the grower's yield should exceed the number of boxes of fruit given below: Oranges, 12.5 boxes; tangerines, 8 boxes; grapefruit, 19.33 boxes; and mixed citrus, 15 boxes.
Also in Citrus Mag. 16(2):12. Oct.1953. 80 C498

512. SAVAGE, Z. Investment in irrigation equipment. Citrus Mag. 13(11):12-13. July 1951. 80 C498
Of the 200 groves keeping records for the Agricultural Extension Service in Florida in 1948-49 about half are irrigated. Approximately half of those irrigated do not own their own equipment for irrigation but rent it. These groves using rented equipment are smaller in size, being 13.4 acres as compared to 85.4 acres for the other irrigated groves. Investment per acre averaged $59.58 or 8 percent of the grower's estimate of the value of land and trees. Investment in irrigation was $63.42 per acre for groves of 19 acres or less, $71.51 for groves of 20 to 99 acres and $31.93 for groves of 100 acres or over.

513. SAVAGE, Z. Irrigated and nonirrigated groves. Citrus Mag. 14(2):23,27. Oct.1951. 80 C498
A comparison in Florida shows only 1 season of 8 from 1941 to 1949 when nonirrigated groves yielded more than irrigated. The average increase with irrigation was 34 boxes per acre. Irrigation costs averaged $15 per acre and increased operating costs were $40 per acre on the irrigated groves. Returns averaged on a net basis $6 per acre more on the irrigated groves. This increase is so small that the need for careful analysis of each situation is very apparent.

514. SAVAGE, Z. On irrigation. Citrus Mag. 19(12): 16. Aug.1957. 80 C498
When citrus-fruit prices are low the average grove cannot afford much irrigation, according to 25 years of records on Florida groves by the Experiment Station and the Agricultural Extension Service. Water costs generally are about $7.50 to $10 per acre-inch. Individual analysis is essential in determining the feasibility of irrigation for citrus in Florida.

515. SAVAGE, Z. Results shown by production records on irrigated & nonirrigated groves. Citrus Indus. 32(9):5,12,17-18. Sept.1951. 80 C49
Economic analysis of citrus groves in Florida regarding irrigation is an individual requirement. Many groves show profit from irrigation while others may consistently fail to cover additional costs. From 1941 to 1949 the irrigated groves keeping records have averaged 398 boxes per acre and the unirrigated 364 boxes. The cost for the same period has been $171 per acre for the irrigated and $131 per acre for the unirrigated. Costs per box were $.43 with irrigation and $.36 without. Returns above costs were $342 with and $336 without irrigation.

516. SAVAGE, Z. Some things growers should consider. Citrus Mag. 17(11):14. July 1955. 80 C498
In 1952-53 the average cost of irrigation on 107 groves in Florida was $14.55 per acre. This was 8 percent of the operating or cash cost. Over the past 10 years the increased yields have not covered these increased costs, so that irrigation has not paid on the average. Better than average groves have made irrigation pay.

517. SELL, O. E. Results of eight years' fertilization and irrigation experimentation on Bermuda-clover pastures. (Sum.) South. Pasture & Forage Crop Impr. Conf. Rpt. 10:19-22. 1953. 60.19 So83
In tests at the Georgia Agriculture Experiment Station supplemental irrigation increased total pasture-forage production, largely through an increase in Ladino-clover production. Irrigation increased the percentage of Ladino by an average of 55 percent, regardless of fertilization treatment used. Irrigation without fertilization increased the Ladino content from 18 percent to 73 percent, and the heaviest fertilization plus irrigation increased the Ladino content from 24 percent to 80 percent. Forage crude protein production was increased twice as much as forage dry matter by supplementary irrigation. Soil and plant analysis both emphasize that greater quantities of plant nutrients are removed from the soil as a result of supplementary irrigation. Higher rates of fertilizer are therefore necessary to sustain pasture production over a period of years.

518. SEWELL, R. F. Irrigated vs. non-irrigated Ladino clover pasture for growing-fattening pigs. (Abs.) Assoc. South. Agr. Workers. Proc. 52:56. 1955. 4 C82
Report from the University of Georgia of an experiment with 2 uniform groups of pigs, fed with similar supplemental diets. Average daily weight gains of 1.2 lb. on irrigated, 1.11 lb. on nonirrigated pasture; feed required to produce 100 lb. of gain, 310.3 and 337.2 respectively. Feed costs for producing 100 lb. of gain were $9.77 and $10.62 respectively. Irrigation expenses were not determined.

519. SITES, J. W., REITZ, H. J., and DESZYCK, E. J. Some results of irrigation research with Florida citrus. Fla. State Hort. Soc. Proc. 64:71-79. 1951,pub. 1952. 81 F66
Experiments at the Florida Citrus Experiment Station with irrigation showed a marked effect on quality and yield. Sizes of the fruit were about one commercial size larger when irrigated. The fruit from irrigated trees contained more juice, fewer soluble solids, and less acid. Production per tree is about 0.5 to 1.1 boxes higher with irrigation of Valencia oranges, and 1.5 to 2.5 boxes per tree higher with Marsh grapefruit.
Also in Citrus Indus. 33(2):5-8,13-17. Feb.1952. 80 C49

520. SMITH. O. E. SCS engineer outlines irrigation possibilities for Florida pastures. Fla. Cattleman 17(12): 62,64. Sept.1953. 43.8 F66
Recommends subirrigation over sprinkler and flood systems, especially where land is fairly level and there is a fairly high natural water table. Costs of subirrigation, exclusive of the cost of clearing, seeding, and fertilization, range from $5 per acre where there is a lake or stream available for water supply, to $50 per acre when a well has to be dug. Annual costs are low. Maintenance, operation of pumps, and amortization of initial cost may be as low as $5 per acre per year unless well-pumping is involved. Pasture irrigation on sandy lands is most common in Martin, Orange, and Clay Counties.

521. SOUTH CAROLINA. CLEMSON AGRICULTURAL COLLEGE. EXTENSION SERV. Cotton irrigation in South Carolina. Clemson Agr. Col. S. C. Ext. Inform. L., May 1957,4 p. 275.29 C59In
Includes costs and returns. The initial cost of sprinkler equipment varies from $70 to $150 per acre, depending on the distance from the source of water, and other factors. Fixed costs run about $20 per acre per year, and operating costs average $5 per acre per application of 1 1/2 in. of water. Tests in 1956 at Clemson showed that irrigation increased cotton-lint yield by 268 lb. per acre, increased cotton-seed yield by 490 lb. per acre, and gave a $70.50 increased net return per acre on both lint and seed. In 1955 (a wet year), tests at the South Carolina Agricultural Experiment Station's Sandhill Branch on corn, cotton, tobacco, and alfalfa, showed the following yield increases due to irrigation: Corn, from 91 to 136 bu. per acre; cotton, from 1,521 lb. to 1,971 lb. per acre; tobacco, from 2,088 to 2,177 lb. per acre; and alfalfa, from 4.7 tons to 8.1 tons per acre.

522. STEVENS, R. F. Tomato irrigation. N. J. Farm & Gard. 27(5):29. May 1956. 6 G162
Experiments at the University of Delaware in 1954 and 1955 with irrigation of tomatoes gave the following general results: Water applied during dry periods early in the season resulted in larger plants, more uniform stands, 100 percent control of blossom-end rot, and an increase in the number of fruit set. The total yield of marketable fruit was increased with each additional irrigation. Water applied during the harvest season brought about an increase in the plant-disease problem. This problem was solved by spacing the later irrigations farther apart and increasing the amount of water applied each time. Altogether, irrigation increased yield by 23 percent and increased fruit size by 35 percent.

523. STOUT, G. J. Some facts about frost and a suggested new way to use irrigation against frost damage. Mkt. Growers J. 86(3):12-13. Mar.1957. 6 M34

The unpredictability of spring frosts in the Southern States makes early planting of vegetables a hazard about 1 year in every 3. Most growers do not have large enough sprinkler systems to protect all their crops during the frost. However, frosts are usually predicted at least 24 hours in advance, and are usually preceded by a bright, sunny day. It is then that the sprinklers should be put to work, storing up moisture in the soil as a heat conductor. The sprinklers can be moved every 2 hours, thus covering a large field during the hours of sunlight. A wet soil absorbs and holds heat much more readily than does a dry one. Adding 10 percent moisture to the top 6 in. of soil will increase the heat-holding capacity of the soil by 50 percent. This stored heat will bring crops safely through the average spring or autumn frost in the Southern States. Florida and Georgia frost frequencies are used as bases.

524. STOUT, G. J. Unusual irrigation systems in Florida. Mkt. Growers J. 84(12):18. Dec.1955. 6 M34

Subirrigation, ditch irrigation and large-spray units are described. No specific costs given.

525. STUART, T. L., and TAYLOR, H. M. Virginia droughts and their effect on agricultural production. Va. U. News Let. 31:1. Oct.1,1954. 280.9 V815

Early historical records indicate that droughts occurred during the early colonial period in Virginia. Agricultural output records started in 1866 and weather records started in 1882. Tables are given showing drought damage to corn, tobacco, and pasture. Yields during the drought year are compared to the average of the previous 5 years. Based on these records the worst drought occurred in 1930 for corn and pasture and in 1869 for tobacco. In decreasing order of severity for corn the years are: 1930, 1953, 1900, 1869, and 1952. For tobacco they are: 1869, 1919, 1900, 1953, and 1921. For pasture they are: 1930, 1953, 1936, 1925, and 1941.

526. TAYLOR, F. J. He's beating summer droughts; farmers in humid South Carolina now insure crops with sprinkler irrigation. Country Gent. 121(7):27,52,54-55. July 1951. 6 C833

A mobile irrigation rig sponsored by Camp Irrigation Foundation in 1947 toured South Carolina farms demonstrating that sufficient moisture could be put on crops to carry them through 4 to 6 summer dry spells for $2 to $3 an acre. Costs of systems to farmers were from $1,000 to $2,000. By 1952 a survey of farmers revealed that irrigated peaches that otherwise would have been thinned to 2 bu. a tree produced 8 to 10 bu. per tree. Irrigated tobacco would yield $600 per acre next to dry-land tobacco producing $100 per acre. Seven heavy cuttings of alfalfa were harvested instead of 3 a year without irrigation. Irrigated cotton yielded a bale and a half per acre, twice as much as nonirrigated. Irrigated corn yielded 162 bu. per acre where the average was 80 bu. per acre.

527. TURNBULL, J. Cooperative work with Soil Conservation Service — citrus studies. In Johns-Manville Corporation. Supplemental irrigation, p. Fla. 12-15. New York,1951. 55 J62

Experiments at the Florida Agricultural Experiment Station on irrigation and its effects on yield, size, and internal quality of oranges and grapefruit. The 1948 harvest of oranges produced 7.94 boxes per tree when not irrigated, 9.01 boxes with 1.5-in. irrigation, 9.22 boxes with 2.5-in. irrigation, and 9.93 with 3.5-in. irrigation. Grapefruit yielded 13.09 boxes when not irrigated, 12.05, 11.6, and 10.68 boxes with 1.5-, 2.5-, and 3.5-in. irrigations, respectively. In this case the freeze of Feb., 1947, damaged the irrigated plots more than the unirrigated. In the 1949 harvest, Hamlin oranges produced 4.03 boxes per tree when not irrigated, and 4.30 boxes when irrigated. Marsh grapefruit yielded 7.56 boxes per tree when not irrigated, and 8.61 boxes with irrigation. In all cases, the irrigated fruits were larger than the unirrigated, the citric acid content was lower, and the Vitamin C content was 1.5 percent higher, the juice per fruit was 13 milliliters greater, and the juice per weight was .9 percent greater in the irrigated fruit than in the unirrigated.

528. VAIGNEUR, H. O. Irrigation can increase cotton yields. S. C. Agr. Res. 3:4-6. Jan./Mar.1956. 100 So8So

South Carolina farmers in 1952 reported an average increase of 390 lb. of seed cotton per acre from irrigation. Clemson tests during the past 3 years resulted in increases of 655, 1,212 and 357 lb. of seed cotton per acre. Fertilized and irrigated, yields ranged from 2,086 to 2,279 lb. per acre. Effects of irrigation on fiber and seed properties are also given.

529. VAN BAVEL, C. H. M., and VERLINDEN, F. J. Agricultural drought in North Carolina. N. C. Agr. Expt. Sta. Tech. B. 122,60 p. June 1956. 100 N81

Drought hazard depends on the water-use rates of the plants, and the available-water-holding capacity of the plant root zone. Twenty-five years of weather records, standard evapotranspiration rates, and soil capacities from 1 to 5 in. were used in this bulletin. This is basic data needed in designing irrigation systems and in providing the needed storage in reservoirs for irrigation. From April through September the plant needs for irrigation would be from 11 to 18 in. on a soil holding only 1 in. in the root zone, and from zero to 8 in. for a soil holding 5 in. in the root zone.

530. VAN BAVEL, C. H. M., FORREST, L. A., and PEELE, T. C. Agricultural drought in South Carolina. S. C. Agr. Expt. Sta. B. 447,36 p. June 1957. 100 So8

Since agricultural drought is the result of soil deficiencies, it is necessary that a study of drought be approached from this standpoint. Weather records for 25 years, standard evapotranspiration rates, and soil-moisture capacities from 1 to 5 in. were used. From April through October the plant needs for irrigation would be from 18 to 22 in. for a soil holding 1 in. in the root zone and 9 to 13 in. for a soil holding 5 in. in the root zone. This is basic data needed in designing an irrigation system and in the needed storage in reservoirs for irrigation.

531. VAN BAVEL, C. H. M., and LILLARD, J. H. Agricultural drought in Virginia. Va. Agr. Expt. Sta. Tech. B. 128,38 p. Apr.1957. 100 V81S

The frequency of agricultural drought is determined from weather records using average water-use rates and soil available-water-holding capacities from 1 in. to 5 in. This data is basic in determining irrigation and water-storage needs for different levels of drought probability. From April through September the minimum water requirement by the plants on a soil holding 1 in. would be about 13 to 17 in., and for a soil holding 5 in. the need would be from 1 in. to 9 in. This is for the driest year in 10 years, and allowance should be made for efficiency of the irrigation system.

532. VAN BAVEL, C. H. M., and WILSON, T. V. Evapotranspiration estimates as criteria for determining time of irrigation. Agr. Engin. 33:417-418,420. Ref. July 1952. 58.8 Ag83

Comparisons were made in 1950 and 1951 at Raleigh, N. C., between actual evapotranspiration rates and those computed by the Penman, Thornthwaite, and Blaney-Criddle formulas. Maximum error from average monthly rates for any of the formulas was 14 percent. A balance system of using average daily rates, root-zone-moisture-holding capacities, and rainfall or irrigation, was found to be quite satisfactory in determining when to irrigate.

533. VAN BAVEL, C. H. M. Irrigating flue-cured tobacco. Better Crops Plant Food 38(2):19-22. Feb.1954. 6 B46

Extensive experimental studies at Oxford, N. C., 1951-53, with and without irrigation, on soils of high and low native fertility. Tables give expectancy of recurrence of the year's season, yield increases, value per 100 lb. in dollars, nicotine and sugar content, economic analysis of experimental results, gross and net profit from crop and its expected recurrence. Net increase in dollars per acre ranged from $69 in 1952 to $295 in 1951. "...with the purchase cost of an average irrigation system being about $125 per acre. The whole system could have been paid for in 1 year in 2 of the 3 years of our experience," p. 49.

534. VAN BAVEL, C. H. M., and WILSON, T. V. Irrigation pays and pays. Res. & Farming [N. C. Sta.] 10(4):6-7. Spring 1952. 100 N81R

Results of a 2-year research project by the North Carolina Agricultural Experiment Station on the effects of irrigation on the yield and quality of tobacco are summarized. Yield in pounds per acre — unirrigated, 1,281 ; irrigated, 1,592. Value in dollars per acre — unirrigated, $587; irrigated, $924; increase in profit, $337 per acre. The quality of tobacco was also improved as irrigation lowered the nitrogen and nicotine content of the leaves and increased the sugar content. Earlier and more even maturing due to irrigation allowed for more favorable curing conditions. The cost of the sprinkler system used in the study was $1,610 including pump, pipes, and revolving sprinklers. The return to the farmer for his labor was increased 35 percent.

535. VAN BAVEL, C. H. M. Irrigation studies: Can we predict drouth? Better Farming Methods 29(4):20-22. Apr.1957. 58.8 B46
Research at the North Carolina State College of Agriculture. Predictions were based on daily rainfall data, daily evapotranspiration losses, and the water-storage capacity of the soil. From these data, water requirements of crops in the Southeastern States can be predicted for 8 or 9 out of every 10 years, depending on location, time of year, and the condition of the soil. This information should be available before an irrigation system is installed.

536. WALLACE, D. S. 1954 drought in Virginia. Amer. Water Works Assoc. J. 47:222-225. Mar.1955. 292.9 Am32J
The 1954 drought was aggravated by the rapid expansion in the use of water for irrigation. Heavy diversion of water from streams that summer reduced the flow downstream to a degree alarming to industrial and municipal users. During the more severe drought of the 1930's there was no such withdrawal to irrigate farm lands. It seems certain that irrigational use of water will increase, and that the situation calls for careful study of water requirements and resources in Virginia so that future droughts will be less disastrous.

537. WALLER, J. A. Irrigation systems in Virginia. South. Planter 111(3):24-25. Mar.1950. 6 So89
Sprinkler irrigation is commonly used in Virginia and this mostly on truck crops. A potato farmer in Northampton County, by using liquid fertilizer in his irrigation water, has produced 30,000 lb. of potatoes per acre compared to an average of 6,000 lb. for adjoining unirrigated farms.

538. WALLIS, W. T. Southern Florida reaps benefits from irrigation. Civ. Engin. 26:452-455. July 1956. 290.8 C49
Martin County has an average rainfall of 55 in. per year, but 2/3 of it falls between June and October, leaving the remaining 7 months very dry. The sandy soil, the flat topography, and the availability of water in the County make a favorable combination for irrigation. Subsurface irrigation has an initial cost of about $25 per acre — $15 for a pump, $5 for a main canal, and $5 for feeder ditches. Maintenance costs are about $1.50 per acre per year, and fixed costs amount to about $3.30 per acre per year. There were 21,000 acres of irrigated land in the County in 1956, and it is estimated that eventually 125,000 acres will be irrigated, with an annual demand for water of 580,000 acre-feet per year.

539. WHAT about the fifth plate? Com. Fert. 87(3): 20-21,24-25,28,30,32,34. Sept.1953. 57.8 C73
The Range Cattle Experiment Station at Ona, Fla., reports native range yielding 15 lb. of beef per acre. Improved range nearby that was fertilized and seeded to better grasses and clovers yielded 229.5 lb. of beef per acre, and when supplementary irrigation was also added the yield was 1,050 lb. of beef per acre. Eighteen different vegetables averaged 35 percent increase in yields for 14 years in Alabama. Cotton yields at Auburn, Ala., increased from 1,449 to 2,538 lb. of seed cotton per acre with irrigation.

540. WHITT, B. M., ed. Progress in soil and water conservation research. U. S. Agr. Res. Serv. Soil & Water Conserv. Res. Br. Q. Rpt. 15,42 p. Ref. Jan./Mar. 1958. 1.965 S2Q2
Irrigation of field corn at Blacksburg, Va., has increased the yield from 79.3 bu. per acre to 109.2 bu. when irrigation is provided only from the tassel through the milk stage. When irrigation was provided for the full season the yield was 119.0 bu. per acre. This is a 4-year average from 1954 to 1957. Average rainfall for the growing season was 12.8 in. and the amount provided by irrigation was 4.5 in. for the critical period only, and 9.0 in. for full-season irrigation. Full-season irrigation as compared to critical-period irrigation changed the yield from an increase of 26 bu. to a loss of 4 bu. in different years. A study of the frequency of agricultural drought and excessive amounts of water has just been completed for the Lower Mississippi Valley area. The report includes Mississippi, Arkansas, Louisiana, and small portions of Missouri, Kentucky, and Tennessee. Excesses and shortages of water can and often do occur the same year but not at the same time. A soil in North Central Arkansas having a water-holding capacity of 3 in. can expect an excess of 25 in. and a shortage of 22 in. of water in 1 out of 10 years. An excess of 20 in. and a shortage of 18 in. can be expected in 2 out of 10 years. An excess of 15 and a shortage of 12 in. can be expected in 5 out of 10 years. These calculations are basic to knowing the amount of irrigation or the amount of drainage needed.

541. WILSON, T. V. Irrigation—watchword for thirsty crops. Farmers Fed. News 33(8):12,17-18. Apr. 1953. 280.28 F225
The cost of irrigation in the Southeastern States is about $3.00 per acre-inch of water applied. Half of this would go for fixed costs, and half for operating costs. During an average season it would be necessary to apply from 4 to 5 in. of water, or in the neighborhood of $12 per acre to irrigate for 1 season. Studies have shown that this amount of irrigation has increased tobacco yields to the value of $350 per acre in North Carolina.

542. WILSON, T. V. Power units for irrigation. Agr. Engin. 35:576-578. Aug.1954. 58.8 Ag83
A comparison of electric motors, gasoline engines, and diesel engines at Raleigh, N. C., shows that it is cheaper to use electric motors in the long run where it is possible to do so. On a single-phase line it is possible to use electric motors up to 7.5 hp. only. Electric motors cost about $7 per hp. per year beyond the 15 hp. size. The cost is higher for the smaller sizes. Gasoline is cheaper than diesel below about 35 hp. The annual cost of gasoline varied from about $13 to $9.50 per horsepower and the diesel varied from about $9.50 to $8 per horsepower.

543. WRIGHT, J. E. Things learned in irrigation practices. Md. Agr. Soc.-Md. Farm Bur. Rpt. 39:142-143. 1954. 4 M366
A Maryland farmer irrigates approximately 350 acres of peaches and 450 acres of apples. Elberta peaches irrigated 7 weeks before harvest with 3 in. water, and 3 weeks before harvest with 2 in. water, had an average size increase of 1/2 in. With improved cultural and irrigation practices, crop-yield increases of 50 percent to 60 percent are expected in 1955.

544. YANDRE, T. Irrigation costs compared for sprinkling, flooding Florida pasture land. Fla. Cattleman 17(9):84. June 1953. 43.8 F66
The higher cost of sprinkler irrigation generally rules it out on land suitable for flooding in Florida, except in areas where the water is high in chlorides or other toxic salts. The cost of irrigating 240 acres with 8 in. of water by sprinkler is approximated as follows: First cost $14,000; operating cost $2,960; maintenance $100; depreciation $900. The cost of flood irrigation with 14 in. of water amounts to : First cost $11,000; operating cost $2,220; maintenance $800; depreciation $500. The initial cost of sprinkler irrigation is $3,000 more, and the annual cost is $440 more than flood irrigation.

545. YOUNG, H. N. Water; the life blood of agriculture. South. Planter 115(12):6,19. Dec.1954. 6 So89
The U. S. Geological Survey estimates that by 1975 industry alone will be demanding 170 percent more water than present needs. Water is very essential for crops, and needs are not evenly distributed. Corn at Blacksburg, Va., requires 4.2 in. or 23 percent of its needs in the month of July. Also discusses legal rights to use water under the riparian doctrine. Recommendations are given for a new water code for the humid East.

546. ZIEGLER, L. W. Irrigation studies with marsh grapefruit on Lakeland fine sand in central Florida. Fla. State Hort. Soc. Proc. 68:39-41. 1955. 81 F66

Average yields, 1951-55, were 12.49 field boxes (of 2.2 bu.) with no irrigation, 14.22 and 15.11 field boxes with 2 different irrigation treatments. Cost per acre for irrigation treatments: $45 and $165; cost per box of additional fruit; $.13 and $.315.

SOUTH CENTRAL STATES

547. ARBOUR, M. B. A new idea demonstrated. Ext. Serv. Rev. 23:197,202. Nov.1952. 1 Ex892Ex
Discusses a demonstration of irrigation practices and equipment used by a Franklin Parish, La., farmer, who began irrigating his cotton in 1949. Prior to irrigation the average yield was 3/4 bale per acre; since irrigation the 4-year average is approximately 1 3/4 bales per acre.

548. ARKANSAS. UNIVERSITY. Irrigation in humid areas. Farm Policy Forum 8(2):7-11. Fall 1955. 281.8 F2274
Discusses briefly results of research at the Arkansas agricultural experiment stations since 1950; for example: Irrigation increased cotton yields an average of 43 percent, 1950-54. Corn in 1953 was increased to 75 bu. per acre as compared with 20 bu. per acre; in 1954, irrigated corn produced 65 bu. per acre as compared with no crop. Sorghum (Tracy) produced 25 tons per acre as compared with 6 tons per acre, nonirrigated. Soybeans did not respond to irrigation in 1954. Average yield increases of irrigated strawberries for 1953-54 were from 137 to 175.9 crates. Includes a table of minimum-annual-yield increases of certain crops necessary to break even on irrigation costs. Initial investment for 100 acres of cotton is about $150 per acre. Overhead, plus depreciation and interest, is about $15.65 per acre. Operating cost, which includes labor, fuel, and maintenance, is about $1.62 per acre-inch of water. An 8-in. application of water is estimated at $28.56 per acre per year.

549. BAUGH, P. If you're thinking about an irrigation system—. Rur. Kentuckian 7(5):13. May 1954. 335.8 K41
Jefferson County, Ky., truck farmers have been irrigating successfully for over 30 years. Recently tobacco and dairy farmers have become interested in irrigation, and their experiences have not always been successful. Some have been victimized by unscrupulous salesmen who sold them systems larger than they needed; others went into it without sufficient study, and without sufficient knowledge of efficient operation. One farmer paid $6,700 for a system to irrigate 10 acres of tobacco, running his fixed and operating costs way beyond any hope of ample return on his investment. Another farmer paid $2,000 for a system to irrigate 3.8 acres of tobacco. At the same time a truck farmer of Jefferson County was irrigating 14 acres with an original investment of $1,500, at a power cost of less than $.40 per acre-inch of water applied. It is pointed out that irrigation is not magic, and that costs and returns must be carefully figured out in advance of investment, and that efficient operation is a must.

550. BEACHER, R. L. Irrigation and adequate fertility. Irrig. Engin. & Maintenance 6(7):15,33. July 1956. 55.8 Ir722
Irrigation profits are dependent upon adequacy of all other factors, such as crop variety, spacing, light and temperature, weed, insect and disease control, and soil fertility. Research has not yet shown just what adequate fertility is, but much more is being learned every year. Many fields in the Mississippi Delta respond only to nitrogen while others in Arkansas have shown needs of lime, potash, or phosphorus. Trace elements have not been shown to be needed in the Delta region.

551. BENEDICT, R. H., and others. Cotton irrigation research in Arkansas. Ark. Farm Res. 3(2):5. Summer 1954. 100 Ar42F
D. A. Brown, B. B. Bryan, and F. W. Snyder, joint authors.
A 4-year study at the Arkansas Cotton Branch Experiment Station and the Delta Substation on the effect of supplemental irrigation on cotton yield, resulted in the following findings: In the driest year, 1952, irrigation increased yield from 1.13 bales to 1.9 bales per acre; the average increase for the 4 years was .45 bales per acre; the optimum rate of application for the Richland silt loam soil was .5 in. per hour; and the average amount of water applied was 6 in. per year.

552. BENNETT, H. W., MERWINE, N., and KIMBROUGH, E. A. Supplemental irrigation for summer permanent pastures in the hill sections of Mississippi. Miss. Agr. Expt. Sta. C. 196,12 p. June 1955. 100 M69
Experiments to determine the value of supplemental irrigation, under various fertilizer treatments, in maintaining an even production of summer permanent pasture herbage, gave the following results: 1950— Irrigation increased production of dry forage in conjunction with only 6 of 12 fertilizer treatments, while irrigation without fertilizer increased production by 10 percent; 1951 — Irrigation increased production in conjunction with all 12 fertilizer treatments, and increased it by 32 percent without fertilizer. 1952 — Increase in conjunction with all 12 treatments and 38 percent increase without fertilizer; 1953 — Irrigation decreased production in all 12 fertilizer treatments, as well as when used separately. This was due to the fact that irrigation had entirely eliminated the spring clover and left only Dallisgrass.
Also in Miss. Farm Res. 18(6):1-3,7. June 1955. 100 M69Mi

553. BERG, P. H. Irrigation potentialities in Arkansas. Amer. Soc. Civ. Engin. Proc. Separate 404,12 p. Feb.1954. 290.9 Am3Ps
The Bureau of Reclamation as a part of a report on the Arkansas, White, and Red River Basins made this study of potentialities of irrigation in Arkansas. Efforts were aimed at determining the needs for irrigation, the probable increase in crop value, and development or construction problems which may be encountered. The total area suitable for irrigation in Arkansas was estimated at 3,425,000 acres. The value of the increase from irrigation would be $83,550,000 at a cost of 34 percent of the increase, or $28,400,000.

554. BERRY, T. E. How's corn irrigation doing in Mississippi? Irrig. Engin. & Maintenance 4(12):17,30. Dec.1954. 55.8 Ir722
A farmer in Bolivar County, Miss., reported corn yields of 75 bu. per acre in spite of a poor stand. He estimated that the crop would have been a complete failure without irrigation. This was flood irrigation and costs were about $8.00 per acre, not including the cost of the well. Another farmer in Washington County had corn yielding 98.5 bu. per acre for a 70-bu. increase in 1954. Several other farmers have reported similar results in 1954 which was a very dry year.

555. BILBREY, K. Water saved their crops. Prog. Farmer, Miss.-Ark.-La. Ed. 68(2):21,26. Feb.1953. 6 So81
Six farmers in Mississippi County, Ark., used irrigation very successfully during the 1952 drought. One farmer gathered 1,400 bu. of peaches from 9 acres irrigated twice. This is about 3 times the State average yield, and a premium of about $.50 per bu. was received. Other farmers were irrigating pasture and strawberries with equal success.

556. BOUWER, H., and HELMS, J. O. Plastic hose a labor saver in sprinkler irrigation. Highlights Agr. Res. [Ala. Sta.] 4(2):3. Summer 1957. 100 AL1H
A sprinkler-irrigation system was tested at Auburn on corn and cotton. The sprinkler head was mounted on a tripod and attached to the lateral line by means of 80 ft. of plastic hose. In this manner the sprinklers could be moved 3 times for each move of the lateral line. Labor-saving by this method was from an average of 1.5 man-hours per acre per irrigation to 1 man-hour. Cost for the tripods and plastic hose was about $20 per sprinkler. There was a saving in numbers of valve tees and pipe so that if labor was valued at $1 per hour the labor saved would pay for the extra cost in about 12 irrigations.
Abs. in Assoc. South. Agr. Workers Proc. 54:46-47. 1957. 4 C82

557. BOWERS, J. L., BENEDICT, R. H., and MCFERRAN, J. Irrigation of sweet potatoes, snap beans, and cucumbers in Arkansas. Ark. Agr. Expt. Sta. B. 578,27 p. June 1956. 100 Ar42
In experiments at the Arkansas Station in 1951-53, average yields of sweetpotatoes for the 3-year period were 183 bu. per acre from the unirrigated check plots, of which 47 percent were U. S. No. 1 grade; 275 bu. per acre from plots irrigated when the soil moisture reached 20 percent,

of which 45.4 percent were U. S. No. 1; and 286 bu. per acre from plots irrigated when the available soil moisture fell to only 50 percent, of which 46.5 percent were U. S. No. 1. Snap beans planted in April 1955 gave the highest yield, 192 bu. per acre, with a combination of 2 in. of supplemental irrigation plus 300 lb. per acre of 5-10-5. The same irrigation combined with 800 lb. of 5-10-5 yielded only 465 bu. per acre. Both fertilizer treatments without any irrigation yielded only 260 bu. per acre; and 2 1/2 in. water plus 300 lb. and 800 lb. of 5-10-5 yielded only 483 and 463 bu. per acre respectively. In cucumber tests in 1952 check plots yielded 250 bu. per acre, of which 17.6 percent were Fancy grade; plots irrigated with 1 acre-inch every 10 days yielded 536 bu. per acre, of which 26.1 percent were Fancy grade; and plots irrigated with 1 1/2 in. every 10 days yielded 824 bu. per acre, of which 30.3 percent were Fancy grade.

558. BOWERS, J. L., BENEDICT, R. H., and WATTS, V. M. Supplemental irrigation of sweet potatoes. Ark. Farm Res. 1(3):2. Fall 1952. 100 Ar42F
Experiments at the Arkansas Fruit and Truck Branch Station with zero, light, and heavy irrigation of sweetpotatoes resulted in the following yields per acre and percentages of U. S. grade No. 1: No irrigation — 336 bu. (44 percent U. S. No. 1); light irrigation (4 1/2 in. total) — 626 bu. (42 percent U. S. No.1); heavy irrigation (8 1/2 in. total) — 667 bu. (47 percent U. S. No. 1).

559. BOWMAR, D. M. Irrigation. 1-3. Blood Horse 69:952-953,969,970-972; 1034,1036,1040,1045,1048; 1126-1127,1141. Apr.23,May 7, May 21,1955. 42.8 T392
Pt. 1 deals with the general aspects of sprinkler irrigation — costs, types of crops most profitably irrigated, design of the system, source of water, etc. Pt. 2 discusses tobacco, vegetable, and pasture irrigation in Kentucky. Low-nicotine tobacco is more in demand than high-nicotine tobacco, and brings a higher price. Tests on 10 Kentucky farms proved that nonirrigated tobacco had a nicotine content of from 4 to 6 percent, compared to only 2 to 3 percent for irrigated tobacco, due to the shorter growing period of the latter. In other tests on 69 farms from 1951-53, irrigated tobacco yielded an average of 2,003 lb. per acre, compared to 1,396 lb. per acre for nonirrigated. Pasture irrigation has proved profitable on dairy farms as well as on beef farms. Steers in 1952 gained 429 lb. per acre on irrigated pasture, compared to 274 lb. per acre on unirrigated pasture. Pt. 3 deals with a large irrigation system installed on a horse-and-tobacco farm in Kentucky. Details of the system are described, but costs are not given.

560. BRACKEEN, L. G. Wells as a source of water for irrigation in Alabama. Ala. Polytech. Inst. Agr. Ext. C. 485:61-62. Aug.1955. 275.29 AL1C
The quantity and quality of water that can be obtained from wells in Alabama vary widely. A knowledge of the geology of an area is needed for selecting a proposed well site. A map of Alabama is enclosed, showing the 11 geological areas of the State and the ground-water conditions of each area.

561. BROWN, D. A., and BENEDICT, R. H. Increasing corn yields through supplemental irrigation. Ark. Farm Res. 2(4):2. Winter 1953. 100 Ar42F
Results of a 1953 corn-irrigation experiment conducted at the Main Experiment Station at Fayetteville were as follows: Yield from an unirrigated plot — 17 bu. without nitrogen, 22 bu. with nitrogen; yield from an irrigated plot — 70 bu. without nitrogen, 75 bu. with nitrogen; shelling percentage — .7 ears per stalk unirrigated, 1 ear per stalk irrigated; defective grains — 2.1 percent for nonirrigated corn, 1.4 percent for irrigated; gross returns per acre — $26.69 for unirrigated corn without nitrogen, $34.54 with nitrogen; $109.90 for irrigated corn without nitrogen, $117.75 for irrigated corn with nitrogen.

562. BROWN, D. A., and BENEDICT, R. H. Increasing crop yields through irrigation. Ark. Farm Res. 3(4): 4. Winter 1954. 100 Ar42F
Research at the Main Experiment Station at Fayetteville in 1954 on irrigation of corn, sorghum, and soybeans, produced the following results: Corn returned no yield without irrigation, 65.86 bu. per acre with irrigation; sorghum (forage) — 5.99 tons per acre unirrigated, 24.85 tons per acre irrigated; soybeans (seed) — 3.66 bu. per acre unirrigated, 6.81 bu. irrigated; soybeans (forage) — .47 tons per acre unirrigated, 1.55 tons irrigated.

563. BROWN, D. A., BENEDICT, R. H., and BRYAN, B. B. Irrigation of cotton in Arkansas. Ark. Agr. Expt. Sta. B. 552,40 p. May 1955. 100 Ar42
Block experiments at the Arkansas Cotton Branch Experiment Station in 1950-54 with the effects of irrigation and fertilization on cotton yield, gave the following results: 1950 — with fertilizer applied at the rate of 400, 800, 1,200, 1,600, and 2,000 lb. per acre, irrigated plots yielded 21, 18, 19, 20, and 31 percent more seed cotton, respectively, than did similarly fertilized unirrigated plots; 1951 — with fertilizer applied at the rate of 400, 800, and 1,200 lb. per acre, irrigated plots yielded 45, 10 and 2.5 percent more than the unirrigated plots; 1952 1952 — with fertilizer applied at the rate of 800 lb. per acre, the irrigated plot yielded 2,701 lb. per acre, to 1,604 lb. for the unirrigated plot; 1953 — with various degrees of subsoiling, the average yield of seed cotton was 2,383 lb. per acre form the irrigated plots, and 1,822 from the unirrigated; rates of fertilization and degree of subsoiling made little difference; 1954 — subsoiling and degree of fertilization made little difference in yield; average yield from the irrigated plots was 2,589 lb. per acre, and 1,394 from the unirrigated plots.

564. BROWN, D. A., and BENEDICT, R. H. Supplemental irrigation helps maintain corn yields. Ark. Farm Res. 5(4):4. Winter 1956. 100 Ar42F
Tests on corn at the Arkansas Agricultural Experiment Station, 1953-56, showed that supplemental irrigation increases yield and improves quality even in wet years. In 1956, when 23.51 in. of rain fell during the growing season, 8 in. of supplementary water increased yield from 65.68 bu. per acre to 120.51 bu., an increase of 54.83 bu. In 1954, the year of lowest rainfall (10.86 in. in the growing season) there was no crop at all on the unirrigated plots, and 65.86 bu. per acre after 14 in. of supplemental irrigation. The value of irrigation that year amounted to $98.79 per acre. The average yield for the 4 years was 45.37 bu. per acre for the unirrigated plots, and 100.74 bu. per acre after irrigation — an increase of 55.37 bu. per acre, with a gross increased value of $79.03 per acre. It was found particularly important to supply adequate water from 2 weeks prior to tasseling until the hard-dough stage of corn growth.

565. BRYAN, B. B., and others. Irrigation of cotton and vegetable crops in Arkansas. Plant Food J. 9:3,14-15. Jan./Mar.1955. 57.8 P692
R. H. Benedict, D. A. Brown and J. L. Bowers, joint authors.
The Arkansas Agricultural Experiment Station began comprehensive experiments with irrigation in 1949. Results summarized are: 1,Rainfall-irrigation-yield relationship; and 2, costs and returns of irrigated cotton. Average acre costs and returns of irrigated and nonirrigated cotton respectively for 1950-54 are: Gross income $340 and $240.73; production costs, sprinkler method $209.47, furrow method $193.43 as against $151.65; net return sprinkler method $130.53, furrow method $146.57 as against $89.08; increase in net returns due to sprinkler irrigation $41.45, furrow, $57.49. Sprinkler irrigation costs averaged 15 percent of total production costs, furrow irrigation averaged 6 percent.

566. BRYAN, B. B., and BENEDICT, R. H. Research on irrigation of cotton in Arkansas. (Abs.) Assoc. South. Agr. Workers Proc. 51:47. 1954. 4 C82
Tests started in 1949 at the Cotton Branch Experiment Station, Marianna, and at Delta Substation, Clarkdale. Engineering studies relating to rates of applying water through a sprinkler system, use of electrical resistance-measuring devices, and irrigation and deep fertilizer placement were made. Other studies using irrigation in combination with various fertilizer materials resulted in yield increases which ranged from .14 to .77 bales per acre, with an average of about .4 bales per acre. Effect of water alone was not determined. About 800 lb. per acre of mixed fertilizer with irrigation gave maximum yield.
Also in Ark. Agr. 32(4):14. Apr.1954. 276.8 Ar42

567. CAMPBELL, J. A. Irrigation for truck crops. Miss. Agr. Expt. Sta. C. 163,8 p. Nov.1951. 100 M69
Gives costs and results of furrow and sprinkler irrigation in Mississippi. Costs of furrow irrigation were: Fixed costs, $2.00 per acre for 30 to 40 acres over a 10-year period; labor costs, $4.00 per acre; fuel costs,

$1.75 per acre for each 2-in. application. Sprinkler irrigation: Fixed costs, $10 per acre for 30 to 40 acres over a 10-year period; labor costs, $2.00 per acre; fuel costs, $3.00 per acre per 2-in. application. Irrigation of tomatoes in 1948 increased yield by 55 boxes per acre, with a net value of $157.50 per acre. Irrigation of sweetpotatoes in 1949 increased yield by more than 4 tons per acre, with a net value of $112.50 per acre. Irrigation of snap beans increased yield by 161 bu. per acre, with a net value of $394.41 per acre.

Also in Miss. Farm Res. 14(11):1,4-5. Nov.1951. 100 M69Mi

568. CAMPBELL, J. A. Irrigation for vegetable crops. Miss. Agr. Expt. Sta. C. 182, 8 p. Mar.1953. 100 M69

Experiments with furrow irrigation in Mississippi of various vegetables gave the following results per acre: Tomatoes — unirrigated, 90 field boxes (6,300 lb.); irrigated, 145 field boxes (10,150 lb.); increase in gross value, $165; cost of production, unirrigated, $140; irrigated, $147.50; increase in net value, $157.50. Sweetpotatoes — unirrigated, 18,322 lb.; irrigated, 26,400 lb. Snap beans — unirrigated, 78.2 bu.; irrigated, 239.2 bu.; increase in gross profit, $393.41; cost of irrigation, $125.20; net profit, $268.21. Sweet corn — unirrigated, 399 doz. ears; irrigated, 1,013 doz. ears.

Also in Miss. Farm Res. 16(3):2. Mar.1953. 100 M69Mi

569. CAMPBELL, J. A. The new approach to irrigation. Amer. Veg. Grower 3(6):12,24. June 1955. 80 C733

Experiments conducted at the Truck Crops Experiment Station in Mississippi in which the combination effect of plant population, and nutrient and moisture supply on the yield of sweet corn was studied. The yield from irrigated plots increased with each increase in plant population, while on the nonirrigated plots the reverse was true. In other experiments, irrigation produced a net increase in value per acre of $157.50 with tomatoes, $120 with sweetpotatoes, and $268.21 with bush snap beans.

570. CROWE, G. B. Irrigation of cotton in the Rain Belt; economic aspects. Cotton Gin & Oil Mill Press 56 (20):47-50. Sept.24,1955. 304.8 C822

Farmer experiences with irrigation in the Mississippi Delta in 1954 indicate that irrigation systems for 250 acres using water from wells cost approximately $5,000, investment in wells about $20 per acre, pumping costs $.25 to $.35 per acre-inch, and to transport water in pipes, $100-$175 per 100 ft. moved. Relative costs per acre of the different irrigation systems averaged: Sprinkler, $48; gated pipe, $43; other furrow methods, $18. Labor averaged 4 hours per acre for sprinkler, 5.6 hours for gated pipe and 4.8 hours for other furrow systems. Total costs of applying water including overhead averaged slightly over $9 per acre per. application for sprinkler and gated pipe and $4.75 for other furrow systems.

A comparison of costs and estimated yield increases due to irrigation on two 620-acre Delta plantations indicates that the irrigated farm realized net returns from $32 to $51 per acre of cropland over the unirrigated farm.

571. DAVIS, D. Will irrigation pay with normal rainfall? Hoard's Dairyman 101:531. May 25,1956. 44.8 H65

Experiences of various Alabama dairyman with pasture irrigation are cited. One dairyman has a $10,000 sprinkler system using a 30-hp. electric motor and pump and 1 1/2 miles of pipe. Operating costs run about $1,000 for the season for 100 acres, or $10 per acre per season. The system, he says, paid for itself the first year. Another dairyman grazes 17 cows on 15 acres of irrigated pasture at a cost for electric power of about $1 per day. His system cost $1,800 and has paid for itself many times over in increased profits. The concensus of Alabama dairymen is that it is cheaper to irrigate than not to, and that irrigation should be practiced throughout the season and not only in times of drought.

572. DEESE, R. E., and others. Costs and returns shown in irrigation of permanent pastures for beef cattle. Miss. Farm Res. 17(8):1,7. Aug.1954. 100 M69Mi

E. A. Kimbrough, T. J. Marlowe, and R. J. Dickerson, joint authors.

Experiments were conducted in 1952 and 1953 at the Mississippi Agricultural Experiment Station to evaluate irrigation in pounds of beef per acre. The 1952 tests produced the following results on 5-acre paddocks: 574 total steer-grazing days on irrigated pastures, 405 on unirrigated; 870 lb. total gain per paddock on irrigated pasture, 587.5 on unirrigated; 174 lb. of beef per acre on irrigated pastures, 117.5 on unirrigated. The 1953 tests resulted in 825 total steer-grazing days on irrigated pasture, and 706 on unirrigated; 850 lb. total gain per paddock irrigated, and 690 lb. unirrigated; beef produced per acre, 170 lb. irrigated, 138 lb. unirrigated. At $17 per cwt. the 1953 increase in beef production amounted to $5.44 per acre, or a net profit of only $1.58, as the irrigation cost was $3.86 per acre.

573. DICKERSON, R., GRISSOM, P., and RANEY, W. A. The selection and use of irrigation equipment for Mississippi. Miss. Agr. Expt. Sta. C. 181,14 p. Mar.1953. 100 M69

Compares the efficiency and cost of three types of irrigation: Sprinkler, furrow, and contour check flooding. Concludes that the latter two methods are less expensive, and that sprinkler irrigation should be used in Mississippi only when the land is not suitable for the other methods. With a sprinkler system valued at $7,000, with labor at $.50 per hour, and with no water charge, the State College has arrived at the following costs per acre per year for each of three crops: Corn (3 irrigations) - $26.05; cotton (3 irrigations) — $21.30; and pasture (5 irrigations) - $26.75. The costs of furrow irrigation are not so precise, but should run about $25 per acre when gated pipe is used, and less when ditches and syphons are employed. Cost of contour flooding cannot be estimated since conditions on each farm are different, but the cost in any case will compare favorably with the other two methods.

Also in Miss. Farm Res. 16(3):1,8. Mar.1953. 100 M69Mi

574. DICKERSON, R. L., and others. Irrigation experiments on crops and pastures. Miss. Farm Res. 15(4):4-5. Apr.1952. 100 M69Mi

F. E. Edwards, H. V. Jordan, H. W. Bennett, and V. C. Harris, joint authors.

Experiments conducted by the Mississippi Agricultural Experiment Station on cotton, corn, and pasture irrigation gave the following results: Cotton, irrigated with a total of 3.65 in. of supplemental water in 5 applications yielded 2,156 lb. of seed cotton, or 811 lb. of lint. No comparative figures were available as there was no control plot. Corn, in 1951, yielded 104.8 bu. per acre when fertilized with 240 lb. of nitrogen per acre and irrigated, and only 83.1 bu. per acre when similarly fertilized and unirrigated, or an increase of 26.1 percent. Pastures without either fertilization or irrigation yielded 65 lb. of daily herbage; with irrigation but no fertilizer, 110 lb.; fertilized but not irrigated, 136 lb.; and both fertilized and irrigated, 215 lb.

575. DICKERSON, R. L., and O'KELLY, J. F. 12 varieties of cotton used in irrigation test. Miss. Farm Res. 16:1,8. Jan.1953. 100 M69Mi

In experiments in 1952 at the Mississippi Agricultural Experiment Station, a total of 6 in. of supplemental water was applied in 5 applications to 12 varieties of cotton, at a cost of $25.80 per acre for labor and fuel. The average results for all 12 varieties were: Pounds of lint per acre — irrigated, 875.25; unirrigated, 670. Total acre value — irrigated, $389.16; unirrigated, $296.50. Total gross profit increase, $92.66 per acre; total net profit increase, $66.86 per acre.

Also in Miss. Agr. Expt. Sta. Inform. Sheet 479,1 p. Jan.1953. 100 M69In

576. DUNCAN, H. R., HOBBS, C. S., and FELTS, J. H. Two years' results in using nitrogen and irrigation on bluegrass, hop and white clover pasture. (Abs.) Assoc. South. Agr. Workers. Proc. 51:75-76. 1954. 4 C82

Results of grazing experiments carried on in 1951-52, at the Tennessee Experiment Station, are given for each of the 3 differently treated plots in averages for the 2 years. Average net returns from pasture per acre were $16.75, $7.54, and $11.02 respectively, for untreated pasture, pasture with ammonium nitrate application, and pasture with the addition of ammonium nitrate plus irrigation when necessary.

577. EDEN, W. G. Effects of irrigation on insect problems. Ala. Polytech. Inst. Agr. Ext. C. 485:32-34. Ref. Aug.1955. 275.29 AL1C

Furrow irrigation has little direct effect on most insects, other than that a few may be killed by drowning. Flood irrigation reduces the soil-insect population but encourages the spread of mosquitoes. Sprinkler irrigation seems to have the greatest effect on insect populations. Irrigated cotton is more apt to be infested with boll weevils than is unirrigated cotton. Irrigated corn seems to be less susceptible to corn earworm infestation than does nonirrigated corn. Excess irrigation tends to cause an increase in root maggots in beans, corn, and cabbage. On the whole, healthier plants tend to resist insect damage more than do unhealthy plants, and in so far as irrigation improves the health of plants, even though insects may multiply in the damp environment created by irrigation, the overall damage from insect pests may be decreased by irrigation properly applied.

578. EDWARDS, F. E., and others. Effects of irrigation on corn and pasture studied. Miss. Farm Res. 14(5):1,7. May 1951. 100 M69Mi

E. A. Kimbrough, R. Dickerson, O. W. Easley, H. W. Bennett, and H. H. Leveck, joint authors.

Results of corn tests at the Mississippi Agricultural Experiment Station. Irrigated plots fertilized with 60, 120, 180, and 240 lb. of nitrogen yielded 2.4, 13.3, 13.4, and 19.8 bu. per acre more respectively than unirrigated plots similarly fertilized. Sprinkler irrigation was used. The pasture tests were inconclusive because rain cancelled out the effects of irrigation.

579. EDWARDS, F. E., KIMBROUGH, E. A., and EASLEY, O. W. Location, construction and use of irrigation ponds studied at State College. Miss. Farm Res. 14(2):7. Feb.1951. 100 M69Mi

Construction of a pond for research work on irrigation at Mississippi State College afforded data on the costs of a farm pond with a capacity of 3.7 acre-feet of water. Average cost arrived at, including constuction of a dam, and installation of an 8-in. pipe under the dam and a main control valve, was $100 per acre-foot, or a total of $370.

580. EMMERT, E. M. Kentucky Agricultural Experiment Station: the use of aluminum foil-lined furrows for irrigating vegetables. (Abs.) Assoc. South. Agr. Workers. Proc. 51:125-126. 1954. 4 C82

Comparative tests were made with a sprinkler system in 1952. With 1/3 or less water used, the furrow system produced 24.4 tons of tomatoes versus 16.6 tons produced by the sprinklers, and 430 bu. per acre of Kentucky Wonder beans vs. 170 bu. produced by the sprinkler system.

581. ENGSTROM, B. Irrigating grasslands. Farm Equip. Retailing 19(2):50-52. Feb.1955. 58.8 F2292

In the humid East, irrigation of pastures is of value because of the fact that droughts sometimes occur during the growing season, and because when rain does come, it too often comes in the form of summer thundershowers in which a great deal of the precipitation is lost by surface runoff. When irrigation is available for the production of pasture, livestock numbers need not be limited to the carrying capacity of the field in a low-rainfall year. In Tennessee, the addition of 13 in. of supplemental water to a pasture has increased grazing days by 49 percent, and has increased milk production by 54 percent.

582. EVANS, E. M. Summary of irrigation research on pastures in Alabama. Ala. Polytech. Inst. Agr. Ext. C. 485:15-18. Aug.1955. 275.29 AL1C

Irrigation for beef production at the Alabama Agricultural Experiment Station, 1952-54. The 3-year average of dry forage per acre for pasture fertilized with 500 lb. of 0-16-8 was 3,560 lb. when not irrigated, and 6,720 lb. when irrigated; for pasture fertilized with 1,500 lb. of 0-16-8 the yield was 3,106 lb. when not irrigated, and 6,930 lb. when irrigated; for pasture fertilized with 1,500 lb. of 0-16-8 plus 120 lb. of nitrogen, the yield was 5,593 lb. without irrigation and 6,988 lb. with irrigation. Average yield of beef per acre per year with the least fertilization was 216.lb. when not irrigated and 420 lb. when irrigated; with the second fertilizer treatment, beef yield was 200 lb. per acre per year without irrigation, and 459 lb. with irrigation; and under the third fertilizer treatment yield was 333 lb. with no irrigation, and 432 lb. with irrigation.

583. EWING, J. A. Irrigated pasture for dairy cows. Tenn. Agr. Exp. Sta. B. 216, 8 p. Apr.1950. 100 T25S

A previous irrigation trial on pasture consisting mostly of Bermuda-grass in 1938 to 1941 indicated that pasture could be irrigated economically for dairy cattle. A seeded and improved pasture was established and irrigation trials started in 1945. During the 4 years 1945-48 the number of cow days of grazing per acre was increased from 149 to 210 with irrigation. Milk production per cow was 21.1 lb. per day with irrigation and 20.5 without, so that most of the increase per acre was increased carrying capacity of the pasture. Milk production increased with irrigation from 3,096 lb. per acre to 4,428 lb. or 43 percent. TDN production per acre increased 55 percent with irrigation from 1,728 lb. per acre to 2,599 lb. Cost of irrigation for an average of 13 in. of water per acre was $20.32 or $1.56 per acre-inch. Income above costs per acre was $141.79 without irrigation and $203.09 with irrigation.

Also in Agr. Engin. 31:24-25. Jan.1950. 58.8 Ag83

584. FLY, I. Strawberry irrigation pays off. Tenn. State Hort. Soc. Proc. 50:14-17. 1955. 81 T25

In 1953 4.7 acres yielded 1,943 16-qt. crates of U. S. No. 1 strawberries. Net profit was $7,568.41. In 1954, net profit was $4,951.49 on 6 acres, after having lost 35 to 40 percent of the potential crop to frost damage

585. GATTIS, J. L., and DEERE, R. Cotton irrigation for Arkansas. Ark. Agr. Col. Ext. C. 477,23 p. June 1956. 275.29 Ar4

Irrigated cotton acreage in Arkansas increased from 116,000 in 1954 to 143,649 in 1955. In tests at the Agricultural College in 1954, nonirrigated cotton grossed $193.65 per acre, compared to $363.25 per acre for irrigated cotton. Production costs exclusive of irrigation were $144.40 per acre for the unirrigated cotton, and $196.50 for the irrigated. Irrigation costs were $30.56 per acre for sprinkler irrigation, and $13.25 per acre when furrow irrigation was possible. This brought total production costs for the sprinkler-irrigated cotton to $227.06, and for the furrow-irrigated cotton to $209.75. Net returns were $49.25 per acre for the nonirrigated cotton, $136.19 per acre for the sprinkler-irrigated cotton, and $153.50 for the furrow-irrigated cotton.

586. GATTIS, J. L. Irrigating cotton in Arkansas. Cotton Gin & Oil Mill Press 54(15):16,46. July 18, 1953. 304.8 C822

Increase in cotton yield which can be credited to irrigation in Arkansas has varied from zero to over a bale per acre. Over a 10- or 20-year period average increases in cotton yield from irrigation are estimated at 25 to 30 percent. At $.32 per lb. this increase in lint yield would be worth $40 per acre, plus $7 for extra seed produced, or a total gross income of $47. Assuming an irrigation cost of $15 per acre, and a cost of $12 for ginning the extra crop, costs would amount to $27 per acre, for a net increased profit due to irrigation of $20 per acre.

587. GATTIS, J. L. Irrigation and other practices. Cotton Gin & Oil Mill Press 55(17):60-61. Aug.14,1954. 304.8 C822

Discusses distribution of fertilizers through irrigation water, and various kinds of surface irrigation of cotton in Arkansas. For high-priced land, the underground pipe system is recommended. For cheaper land small lined canals and temporary head ditches are more economical. Under most conditions irrigation is conductive to mechanized harvesting, as there is more uniformity of the crop, the bolls are larger, with fewer "knotty" bolls, and there is better distribution over the stalk.

588. GATTIS, J. L. Is supplemental irrigation needed in Arkansas? Ark. Farmer 52(3):12-13. Mar. 1950. 6 Ar42

Farmers report the following results from supplemental irrigation in various counties of Arkansas: Cotton — 250 lb. per acre before irrigation, 640 lb. per acre after; corn — 30 bu. per acre before, 70 to 111 bu. after; tomatoes — 2 tons per acre before, 7.2 tons after. Data is given on number of droughts and their length from 9 weather stations in Arkansas.

589. GERDES, F. L. Mississippi irrigation tests are reported. Cotton Gin & Oil Mill Press 56(4):42-43. Feb.12,1955. 304.8 C822

In tests at the Mississippi State College of Agriculture in 1952, frequent irrigations of cotton, totaling 6 in. during the season, produced the following results: Lint per acre increased from 633 lb. to 923 lb. for Coker cotton, from 720 to 977 lb. for Plains cotton, and from 645 to 915 for Bobshaw 1A; the total value per acre increased from $281 to $415 for Coker, from $313 to $430 for Plains, and from $282 to $399 for Bobshaw 1A; fiber length and strength of all varieties were increased with irrigation.

590. GILES, W. L. Integration of good management practices with irrigation needed for maximum returns. Cotton Digest 28(42):9,24. June 30,1956. 286.82 C822
Results at the Delta Branch Experiment Station, Stoneville, Miss. of fertility experiments have shown that 60 lb. of nitrogen per acre on oats for grain is a safe amount. Deep tillage on hardpan has obtained increases of more than 1,600 lb. of seed cotton per acre. Over a 3-year period of tests, irrigated cotton fertilized with 120 lb. of nitrogen yielded over 300 lb. of seed cotton more per acre than irrigated cotton with only 60 lb. of nitrogen. Insect-controlled-nonirrigated cotton yielded more than twice as much as irrigated where insects were not controlled, in a test in 1953.

591. GRISSOM, P., RANEY, W. A., and HOGG, P. Crop response to irrigation in the Yazoo-Mississippi Delta. Miss. Agr. Expt. Sta. B. 531,24 p. May 1955. 100 M69
Experiments with the effects of frequency of irrigation on crops in Mississippi gave the following results in 1954: Cotton — no irrigation, 2,443 lb. per acre; 2 irrigations, 2,959 lb.; 5 irrigations, 3,437 lb.; 7 irrigations, 3,465 lb. Corn — no irrigation, 73 bu. per acre; 1 irrigation, 77.1 bu., 3 irrigations, 94.9 bu., 4 irrigations, 98.9 bu.
Also in Miss. Farm Res. 18(5):1-5,8. May 1955. 100 M69Mi

592. GRISSOM, P. Irrigation and quality of cotton in the Mississippi Delta. Cotton Gin & Oil Mill Press 56(21): 12-13. Oct.8,1955. 304.8 C822
Tables show fibre properties and spinning-test results of irrigated and nonirrigated cotton. Evaluation of data, 1952 and 1954, indicates difference between irrigated and nonirrigated cotton was no greater than might be expected when cotton grown with adequate rainfall is contrasted with dry years.

593. HALE, E. B. Irrigation's place in fruit production. Tenn. State Hort. Soc. Proc. 48:37-40. 1953. 81 T25
In spite of the heavy annual rainfall in Tennessee, irrigation has increased from 35 irrigated farms in 1950 to over 500 in 1953, because of the unreliability of the natural rainfall pattern. Five-year tests at the Tennessee Agricultural Experiment Station at Dandridge on irrigation of truck crops showed the following results. Bush beans: Irrigated, 7,069 lb. per acre; unirrigated, 2,450 lb. per acre. Cabbage: Irrigated, 19,420 lb. per acre; unirrigated, 6,996 lb. Broccoli: Irrigated, 9,104 lb. per acre; unirrigated, 2,913 lb. Tomatoes and strawberries were least responsive to supplemental irrigation, showing an average 49 percent increase in yield over nonirrigated.

594. HANSON, D. Irrigation, the Midwest's newest help. Successful Farming 48(8):44-45,78,80. Aug.1950. 6 Su12
The Middle Tennessee Agricultural Experiment Station carried on a 4-year study of supplemental irrigation on dairy-cow pastures. At an average cost of $1.25 per acre-inch, the irrigated pasture produced 43 percent more milk, 61.3 percent greater average returns above feed and irrigation costs; and the cows on the irrigated pasture required 34 percent less supplementary feeding than the cows on the unirrigated pasture.

595. HELMS, J. O. Results of operational cost study of irrigation system. Ala. Polytech. Inst. Agr. Ext. C. 485:27-30. Aug.1955. 275.29 AL1C
Irrigation of cotton at the Alabama Polytechnic Institute was found to cost $1.95 per acre-inch in 1954. This cost was based on each 1.88-in. application, which required 2.65 man-hours of labor per acre, and 3.53 gal. of gasoline per acre-inch. With labor at $.75 per hour, and gasoline at $.25 per gal., the variable costs per acre per 1.88-in. application were $1.66 for gasoline and $1.99 for labor, or $3.65 per acre per 1.88-in. application, and $1.95 per acre-inch. Corn irrigation was found to cost $1.85 per acre-inch, based on a 2.2-in. application. Labor for each application required 2.82 man-hours at $.75 per hour, or $2.12 per application. It took 3.59 gal. of gasoline at $.25 per gal. for each acre-inch, or $1.97 for each 2.2-in. application. The total cost per application was $4.09, or $1.85 per acre-inch. The article does not say so, but one assumes that sprinkler irrigation was used.

596. HERNANDEZ, T. P., HERNANDEZ, T., and SISTRUNK, W. A. Irrigation studies on sweet potato production. (Abs.) Assoc. South. Agr. Workers. Proc. 52: 117. 1955. 4 C82
Studies carried on at Louisiana State University in 1953-54 with 2 varieties of sweetpotatoes on the effects of different moisture levels on production, with special reference to yield, soil moisture, root growth, skin color, and depth of planting. Results are given sometimes for total yield of irrigated and nonirrigated plots, and sometimes for differences in yields of these plots. In 1953 an increase over nonirrigated plots of 62.3 to 66.3 per acre resulted. In 1954 irrigated plots produced 451.2 bu.; nonirrigated 52.2 bu.

597. HOFFMAN, W. R. Financing irrigation systems through banks. (Abs.) Ala. Polytech. Inst. Agr. Ext. C. 485:36. Aug.1955. 275.29 AL1C
Under this Alabama plan, the farmer pays 1/3 of the equipment cost and the bank finances the remainder. Loans are usually for a 3-year period.

598. HOLCOMBE, J. L., and WIEGMANN, F. H. Drought intensity and irrigation needs for cotton in the St. Joseph area. La. Agr. Expt. Sta. DAE C. 185,47 p. Dec.1955. 100 L935
Calculation of drought hazard for cotton, 1914-54, and a method of investigating drought hazard and the need for irrigation.

599. HUNT, R. Better burley with irrigation and insect control. Prog. Farmer, Ky.-Tenn.-W. Va. Ed. 67(12): 19,112. Dec.1952. 6 P945K
In Kentucky, irrigated tobacco brought $.61 per pound in 1951, compared to $.55 for unirrigated tobacco.

600. HUNT, R. Irrigated burley doubled in yield. Prog. Farmer, Ky.-Tenn.-W. Va. Ed. 67(11):15,132. Nov. 1952. 6 P945K
Not only does irrigation produce at least 600 lb. more leaf to the acre, but tests have shown that it produces tobacco that contains a higher percentage of the desirable smoker grades, matures earlier, and has a more favorable curing season than later crops.

601. HUNT, R. What about tobacco irrigation? Prog. Farmer, Ky.-Tenn.-W. Va. Ed. 68(4):28,179. Apr. 1953. 6 P945K
Earlier maturing caused by irrigation produces more bright leaf and less red leaf and tips, hence demands a higher price at auction. Also total production is increased by irrigation. In Kentucky, irrigated tobacco averaged 2,039 lb. per acre, and sold for $1,224.75 per acre, compared to a production level of 1,396 lb. per acre on unirrigated fields, which sold for an average of $726.41 per acre.

602. HURST, F. J. Biggest yields they ever harvested. Prog. Farmer, Miss.-Ark.-La. Ed. 68(2):19,28. Feb. 1953. 6 So81
A farmer near Crystal Springs, Miss., irrigated cabbage and harvested 14 tons per acre, and followed this crop with 80 bu. corn on the same land. Another harvested 87 bu. per acre from irrigated corn that would have been a virtual failure without irrigation. Several farmers were using sprinkler irrigation on pasture with very satisfactory results.

603. KATTAN, A. A., and FLEMING, J. W. The response of snap beans to irrigation at different growth periods. Ark. Farm Res. 5(2):3. Summer 1956. 100 Ar42F

The Arkansas Agricultural Experiment Station at Fayetteville created artificial drought conditions on check plots. Irrigation water applied during periods of blooming and pod development produced returns of 8.64 tons per acre; plants kept dry through pod development produced 2.59 tons per acre. Irrigated at all periods, plants produced 8.88 tons per acre.

604. KELLEY, O. J. Proper water use for increased yields. Cotton Gin & Oil Mill Press 55(5):68-69,81. Feb.27,1954. 304.8 C822
Experimental work in Arkansas indicates that from 35 to 44 droughts have occurred in the past 20 years, and that the average response with cotton is about a 25 percent to 35 percent increase in yield. The average increase for cotton in Georgia from 1949 to 1953 was 58 percent. Missouri reports an increase in 1953 from 1,414 lb. to 3,458 lb. with irrigation.

605. KENTUCKY. UNIVERSITY. EXTENSION SERV. Pasture in Kentucky. Ky. Agr. Col. Ext. C. 510,rev., 108 p. Ref. Apr.1954. 275.29 K415
Irrigation of pasturelands in Kentucky, p. 35-38, summarizes experiments at two experiment farms with irrigation of grazing lands, 1951-52. At Steelway Farm, in 1951, beef cattle grazed on nonirrigated pasture gained an average of 351 lb., while on pasture irrigated with 21 acre-inches of water at $2.30 per acre-inch, beef cattle gained an average of 429 lb. In 1952 nonirrigated pasture produced an average gain of 274 lb., while pasture irrigated with 15 acre-inches of water at a cost of $2.68 per acre-inch, produced an average gain of 429 lb. At the Lexington Experiment Station Farm dairy cattle grazed on unirrigated pasture produced an average of 7,594 lb. of milk in 1951, while on irrigated pasture, 10,045 lb. was produced. When nitrate fertilization was combined with irrigation the yield was only 10,033 lb.

606. KIMBROUGH, E. A. Dependable water supply for irrigation in the Southeast. (Abs.) Assoc. South. Agr. Workers. Proc. 54:55-56. 1957. 4 C82
Wells have been used as economical sources of water in the Delta regions near rivers or where ground water is near the surface in large quantities. Logical sites for reservoirs are near the bluff line on tributary streams. Deep wells in the hill section of Mississippi are generally too expensive for widespread use. Investment in a deep well at Holly Spring, Miss., was $200 per acre and pumping cost was $4.00 per acre-inch. This is much too expensive for most uses.

607. KIMBROUGH, E. A., WISE, L. N., and MCGUIRE, W. S. Fertilization better than irrigation in grass test. Miss. Farm Res. 18(4):2. Apr.1955. 100 M69Mi
Tests with Coastal Bermudagrass were conducted at the Mississippi Agricultural Experiment Station in 1954 to determine the relative value of irrigation and fertilization in terms of dry forage per acre. The unirrigated pasture yielded from 5,850 lb. per acre with no fertilization to 19,610 lb. with 800 lb. of nitrogen. The irrigated pasture yielded from 7,180 lb. with no fertilization to a maximum of 23,350 lb. with 600 lb. of nitrogen. The total increase was 1,330 lb. on irrigated, unfertilized pasture to 5,550 lb. for irrigated pasture fertilized with 600 lb. of nitrogen. The irrigated pasture most heavily fertilized (with 800 lb. of nitrogen) yielded only 21,120 lb. of dry forage — 2,230 lb. less than the more lightly fertilized pasture.
Also in Miss. Agr. Expt. Sta. Inform. Sheet 510,2 p. Apr. 1955. 100 M69In

608. KIMBROUGH, E. A. Irrigation in the humid areas. Amer. Soc. Civ. Engin. Proc. 83(IR2, 1352),13 p. Sept.1957. 290.9 Am3Ps
Humid-area irrigation involves problems of climatology, agronomy, engineering design, water resources and development, and economics. Sprinkler irrigation is to be preferred for small farms, for hilly regions where land leveling is not feasible, and for sections where water supply is scarce, and drainage is poor. Furrow irrigation is to be preferred on level land, in tall-growing crops, and where water is plentiful. Furrow irrigation requires less labor than sprinkler irrigation, and in most cases power costs are lower with furrow than with sprinkler irrigation. Cites examples of yield increases of cotton and corn at Stoneville, Miss., after furrow irrigation.

609. KIMBROUGH, E. A., and others. 1954 cotton variety and irrigation; tests in the hill sections of Mississippi. Miss. Agr. Expt. Sta. B. 525,8 p. Jan.1955. 100 M69
J. F. O'Kelley, B. C. Murphy, B. C. Hurt, and S. P. Crockett, joint authors.
Twelve cotton varieties studied at Mississippi State College, with and without irrigation, gave the following results: The increase in pounds per acre of lint ranged from 990 for irrigated Acala as compared to 730 for unirrigated, to 653 for irrigated Wilds as compared to 552 for unirrigated; the average increase in pounds per acre for all 12 varieties was 182. The acre value ranged from $412 for irrigated Acala as compared to $303 for unirrigated, to $319 for irrigated Bobshaw as compared to $246 for unirrigated. Total average increase in dollars per acre for all 12 varieties was $83.
Also in Miss. Farm Res. 18(1):3. Jan.1955. 100 M69Mi

610. KING, A. L. Drouths; they come oftener than you think. Acco Press 34(10):10-11. Oct.1954. 6 Ac2
The Memphis Weather Bureau Office records, 1872-1954, show an average of 3 droughts per season (April through August). In 6 years out of 10, 60 or more drought days during the season may be expected.

611. KING, R. M. Water problems of the Arkansas and Mississippi rice grower. Rice J. 54(5):11-12,14. May 1951. 59.8 R36
The rule of thumb formerly was 10 gal. per minute from wells for each acre to be irrigated, but many farmers in Arkansas are now doing very well with 5 gal. per minute. Proper leveling, canals, levees, and reservoirs have made this possible. A well having a water level of 50 ft. will draw down to 100 ft. when being pumped at the rate of 1,600 gal. per minute and requires a 60-hp. motor. The same well will draw down to 78 ft. when being pumped at the rate of 900 gal. per minute and requires only 25 hp. Pumping at the lower rate gives 36 gal. per minute per horsepower as compared to 27 gal. per minute per horsepower at the higher rate of output. This is a very important consideration in figuring costs of operation.

612. KUMMER, F. A. Summary of research on irrigation of row crops in Alabama. Ala. Polytech. Inst. Agr. Ext. C. 485:18-19. Aug.1955. 275.29 AL1C
Cotton-irrigation experiments at Auburn in 1950 and 1952-54 indicated that irrigation increased oil content of seed cotton, increased weight per boll, and increased fiber length and weight, but decreased fiber strength. Yields were increased with irrigation by 1,089 lb. per acre in 1952, by 115 lb. per acre in 1953, and 1,524 lb. in 1954. In 1950 irrigation decreased yield by 275 lb. per acre, due to a heavy rain following the irrigation period. Irrigation of corn caused a yield increase of 50 bu. per acre in 1950, 53 bu. per acre in 1952, no increase in 1953, and a 65-bu.-per-acre increase in 1954.

613. LAMOREAUX, P. E. Ground-water program in Alabama. Ala. Polytech. Inst. Agr. Ext. C. 485:42-50. Aug.1955. 275.29 AL1C
So far Alabama has been blessed with ample ground-water supplies. Reconniassance surveys have been completed for the entire State. Detailed studies are completed or in progress in 12 counties. In recent years many of the requests for information on ground water have been for irrigation purposes. The geological divisions of the State are described.

614. LILLARD, J. H. What irrigation has achieved Elect. Farm Mag. 27(6):9-11. June/July 1954. 335.8 EL27
In 1953 a Kentucky farmer irrigated tobacco and averaged 1,700 lb. per acre as compared to 1,030 lb. where not irrigated. Price of the irrigated tobacco was $61.42 per hundred as compared to $52.10 from the unirrigated. Three irrigations on 15 acres of pasture during a 40-day drought the same year provided pasture for 80 calves. Irrigation on a new pasture seeding also saved it from complete failure. The application of 10 in. of water to tobacco increased the value of the crop by $316 per acre. A similar amount applied to corn gave a yield of 152 bu. per acre as compared to 60 bu. without irrigation. Application of 16 in. of water to pasture increased the cow days of pasture by 83 percent.

615. LUNO, G. A. Even low lands can need irrigation. Prog. Farmer, Miss.-Ark.-La. Ed. 68(2):23. Feb. 1953. 6 So81
A cotton farmer in Franklin Parish, La., with irrigation averaged over 2 bales of cotton per acre from 1949 to 1951. He spent $19 per acre for fertilizer last year which is about twice the normal rate.

616. LUSH, R. H. Costs and returns from pasture irrigation. Plant Food J. 8(4):14-15,26. Oct./Dec.1954. 57.8 P692
Early returns from irrigating pastures are reflected in the 5-year average increase for 1945-49 at the Middle Tennessee Experiment Station: 38 percent in milk and $54.77 in greater returns per acre over nonirrigated pasture. Rotational grazing was begun at the Dairy Experiment Station, Lewisburg, Tenn., in 1950. For 1951-54, the average cost of irrigating was $50.20 per acre, or $2.51 per acre-inch for labor, gasoline, oil, repairs, and depreciation. Milk produced was valued at $522.42 per irrigated acre as compared with $335.28 without irrigation. Increases due to irrigation were 61 percent in number of days of grazing, 61 percent in milk production and 38 percent in income above costs.
Also in Natl. Joint Comt. Fert. Appl. Proc. 30:66-67. 1954. 57.9 N216

617. LUSH, R. H. Pasture irrigation, techniques and results in Tennessee. (Sum.) South. Pasture & Forage Crop Impr. Conf. Rpt. 10:18-19. 1953. 60.19 So83
In experiments at the Tennessee Dairy Experiment Station, 1951-52, 20.5 in. water was applied to a Ladino-clover-orchardgrass pasture between May 1 and Oct. 1, at a cost of $2.49 per acre-inch. The 2-year average under irrigation was 49 percent more cow days of grazing, 54 percent more 4-percent fat-corrected milk, and a net return of $115.53 per acre over the unirrigated pasture. Irrigation increased the percentage of Ladino clover in the pasture, and decreased the percentage of orchardgrass.
Also Abs. in Assoc. South. Agr. Workers. Proc. 50:200. 1953. 4 C82; and in J. Anim. Sci. 12:940. Nov.1953. 49 J82; and in J. Dairy Sci. 35:596. June 1953. 44.8 J822

618. MCVEY, J. L. Cut irrigation costs through planning, engineering, management, for profit. Miss. State Col. Ext. P. 302,4 p. Apr.1955. 275.29 M68Ext
Discusses the importance of water supply, soil-available-moisture-holding capacity, and method of irrigation in saving water costs.

619. MCVICKAR, M. H. Fertilizer and irrigation, an unbeatable team. Natl. Fert. Rev. 29(2):3-5. Apr./June 1954. 57.8 F414
Fertilization of a Kentucky tobacco field boosted yield to 1,030 lb. per acre. Fertilization with irrigation boosted yield to 1,700 lb. per acre. The unirrigated tobacco sold for $.52 per lb., and the irrigated for $.615 per lb., giving a gross increased profit of $509.90 per acre with irrigation. In Tennessee an irrigated pasture brought an increase in milk production amounting to $115.53 per acre. An Arkansas farmer harvested 22 bu. of corn per acre before irrigating, while after irrigation, and using the same fertilizer methods, his harvest was 75 bu. per acre. His gross returns without irrigation were $34.54 per acre, and were $117.75 per acre after irrigating.

620. MCWHORTER, J. C. Need for irrigation shown by records of droughts. Miss. Farm Res. 19(6):4-5. June 1956. 100 M69Mi
Review of 46 years of weather records at State College, Miss., shows more than 3 droughts per year.

621. MAYEUX, M. M. Does it pay to water growing crops? Prog. Farmer, Miss.-Ark.-La. Ed. 68(3):21,180. Mar.1953. 6 So81
Farmers in Louisiana report on results with irrigation: A truck farmer increased the yield of tomatoes to 3,500 lb. per acre as compared with 2,200 lb. per acre for the unirrigated field; cost on a 3-acre field irrigated twice was about $2.50 per irrigation. A yield of 750 lb. of lint cotton per acre on 230 irrigated acres as compared with 500 lb. per acre for unirrigated cotton was reported; irrigation cost was less than $7 per acre. Another cotton farmer reported a 200-lb. lint increase on 40 acres with 2 irrigations. One hundred and twenty acres of cotton, irrigated at a cost of $8 per acre for 2 applications resulted in 1/2 bale-per-acre increase in cotton.
On Arkansas demonstration farms, yields of Kobe Lespedeza and tomatoes have multiplied 3 1/2 times, green beans 3 times, and cotton 1 1/2-2 1/2 times when irrigated. Arkansas University Agricultural Engineering Department reported that use of fertilizer with irrigation on cotton shows increases of 14-33 percent.
Mississippi Experiment Station found that irrigation increased yields of fertilized pastures 39 percent during July and August and 79 percent during September and October, 1951. Yield without fertilization was increased 62.4 percent.

622. MISSISSIPPI. AGRICULTURAL EXPERIMENT STATION. Crop response to irrigation in Mississippi. Miss. Agr. Expt. Sta. C. 180,12 p. Mar.1953. 100 M69
Irrigation experiments conducted in Mississippi in 1952 showed the following effects on crop production: Sorghum (silage) — 36,078 lb. per acre unirrigated, 46,199 lb. irrigated; corn (silage) — 14,661 lb. per acre unirrigated, 31,765 lb. irrigated; field corn — 63 bu. per acre unirrigated, 92.7 bu. irrigated; seed cotton — 1,100 lb. per acre unirrigated, 2,006 lb. irrigated; soybeans — 29.1 bu. per acre unirrigated, 38.7 bu. irrigated. Costs of irrigation varied from $12 per acre to $32.15 per acre. The average cost of an acre-inch was $5.00 when a sprinkler system was used, and $1.00 for contour-flooding, pumping from a lake or stream. Data is given to show frequency of drought based on weather records.
Also in Miss. Farm Res. 16(3):1,5. Mar.1953. 100 M69Mi

623. MURPHY, B. C. Fifty inches of rain not withstanding, Mississippi's not all wet. Irrig. Engin. & Maintenance 3:10-11. Apr.1953. 55.8 Ir722
Even though the average rainfall is 50 in. in Crystal Springs, Miss., almost every year has a dry period when irrigation is useful. A 2-year average for sweet corn in 1951-52 was 1,015 doz. ears per acre on the irrigated area and 399 doz. per acre on the unirrigated area. Tomatoes were increased 55 boxes per acre with 1 irrigation. With snap beans the yield was increased from 78 to 239 bu. per acre in 1951 for a gross increase in returns of $394.41 per acre.

624. MURPHY, B. C. Irrigation plots yield more in sweet corn test. Miss. Farm Res. 17:8. Jan.1954. 100 M69Mi
A continuation of the 1951-52 tests described by Murphy in the Feb. 1953 issue of Mississippi Farm Research. The 3-year average yield, 1951-53, was 1,082 doz. ears per acre of marketable corn with irrigation, and 501 doz. without irrigation, an increase of 581 doz.

625. MURPHY, B. C., and MOORE, E. L. Irrigation returns $153 per acre in sweet corn study. Miss. Farm Res. 16(2):1,8. Feb.1953. 100 M69Mi
A continuation of the 1951 tests described by Windham and others in March 1952 issue of Mississippi Farm Research. The 1952 tests, using the same fertilization and spacing as in 1951, yielded 974 doz. ears of corn when irrigated, and 217 doz. when unirrigated. The 2-year average was 1,013 doz. ears per acre irrigated and 399 doz. unirrigated, an increase of 614 doz., or 153 percent in favor of irrigation. This study is also related to fertilizer use and plant spacing. Indications are that 500 lb. of 6-8-8 applied before planting and 32 lb. of nitrogen as a sidedressing are sufficient. Spacing of 2 stalks per hill for irrigated and one stalk for unirrigated corn is best.

626. NETTLES, V. F. Southeast growers now "irrigation-minded." Mkt. Growers J. 82(5):16-17,44-45. May 1953. 6 M34
Experiments with vegetables, conducted by the TVA in Tennessee over a 5-year period, showed that irrigation increased cauliflower yields by 44 percent, broccoli yields by 26 percent, and brussels-sprouts yield by 5 percent. Irrigation experiments conducted at the Mississippi Agricultural Experiment Station resulted in increased yields of 55 boxes of tomatoes per acre, 4 tons of sweetpotatoes per acre, and $268.25 worth of beans per acre. At the Alabama Agricultural Experiment Station, in 33 of

55 tests with irrigation of vegetables, yield was increased 10 to 50 percent in 20 cases, and more than 50 percent in the remainder.

627. NOW TAKE a soybean crop. Irrig. Engin. & Maintenance 6(9):14-15. Sept.1956. 55.8 Ir722
In 1955 over 100,000 acres of soybeans were irrigated in Arkansas as compared to 38,000 in 1953. Experiments in 1955 at the Experiment Station showed yields approximately doubled with irrigation. Yields without irrigation were 16.31 bu. per acre and with irrigation they were 31.30 bu. per acre. There was little or no difference between 3 and 5 irrigations during the season.

628. PARKS, W. L. Response of field crops to supplemental irrigation in Tennessee. Soil Sci. Soc. Fla. Proc. 15:149-153. 1955. 56.9 So32
Studies at the Tennessee Agricultural Experiment Station to determine the maximum soil-moisture tension that may be reached without reducing crop yields, and to determine fertilizer needs of crops at this moisture tension. Sudangrass for forage was used in the study. The maximum soil-moisture tensions reached before irrigation were 2, 5, and 9. A nonirrigated treatment was also used. The fertilizer levels were 30,60,90, and 120 lb. of nitrogen. Results showed that irrigation at the 2-atmosphere level, combined with 120 lb. of nitrogen per acre, yielded the most forage. A total of 4,325 lb. of dry matter per acre in 4 cuttings was yielded with this treatment. The smallest yield, 1,953 lb., resulted from no irrigation and 30 lb. of nitrogen. Without irrigation, but with 120 lb. of nitrogen, the yield was 2,066 lb. Irrigation at 5 atmospheres, with 120 lb. of nitrogen yielded 4,152 lb., and irrigation at 9 atmospheres with 120 lb. of nitrogen yielded 3,139 lb.

629. PASTURE irrigation in Kentucky, In Johns-Manville Corporation. Supplemental irrigation, p. Ky. 1. New York,1951. 55 J62
At the Kentucky Agricultural Experiment Station at Lexington in 1949, an irrigation-nitration study was conducted on a 4-acre pasture. The field was divided into 4 parts of 1 acre each, 2 parts to be irrigated, the other 2 to remain unirrigated. One of the irrigated fields and one of the unirrigated fields received 25 lb. of nitrogen in July and again in September. The irrigated fields received 1 acre-inch of water at the end of each 10 days in which there had been less than 1 in. of rain. Total yields obtained by grazing and clipping were 42 and 35 percent larger respectively from nitration than from no nitration, 72 and 22 percent larger respectively from irrigation than from no irrigation, and 77 and 60 percent larger from irrigation and nitration than from no treatment.

630. PEARSON, R. W. The irrigation research program in Alabama. Ala. Polytech. Inst. Agr. Ext. C. 485: 7-9. Aug.1955. 275.29 AL1C
Research being conducted in Alabama covers irrigation of truck crops, forage crops, grasses, legumes, and pastures, fertilization of irrigated crops, effects of irrigation on plant disease and insects, and methods, schedules, and costs of irrigation.

631. PENN, M. B. Electric motors as a source of power for irrigation. Ala. Polytech. Inst. Agr. Ext. C. 485:25-27. Aug.1955. 275.29 AL1C
Single-phase electric pumps have been found adequate in Alabama for irrigating less than 3 acres of land. A truck farmer irrigated 1/3 acre of beans with a single-phase system attached to his household water supply, and sold $500 worth of beans over his usual gross for the 1/3 acre. For larger areas, however, 3-phase motors are required. A dairy farmer irrigated 50 acres of pasture for 7 months for a total cost of $450 per year, or $9.00 per acre per year. His 15-hp. pump used 23,000 kw.-hr. at a cost for electricity of $.019 per kw.-hr. A nurseryman irrigated 25 acres with a 25-hp., 3-phase pump. The cost of irrigation for 12 months of constant application was $612 or $24.48 per acre. Where electricity is available, electric pumps will be found to require less maintenance, to operate longer, and to be more economical than pumps operated with other fuels.

632. PRICE, C. W. Irrigation: South's "New Frontier." Prog. Farmer, Miss.-Ark.-La. Ed. 70(6):26-27. June 1955. 6 So81
The Louisiana State University Department of Agricultural Economics has found that in Louisiana the investment in irrigation equipment varies from $1,750 for a 10-acre farm to $10,600 for a 300-acre farm, while the cost of one irrigation, including labor and fuel, varies from $19.50 for 10 acres to $390 for 300 acres. After irrigation sweetpotato yields increased from 100 to 385 bu. per acre, and cotton fields yielded up to 750 more pounds of lint per acre.

633. PRITCHETT, E. H. Fighting frost with irrigation. Prog. Farmer, Miss.-Ark.-La. Ed. 68(5):155. May 1953. 6 So81
An early frost struck Arkansas just 5 days before snap-bean-harvesting time. Most of the snap-bean crop was ruined, but one farmer, who had a sprinkler system, started sprinkling 5 of his 30 acres of beans at 2 a. m., and continued until 6 a. m. There was no damage to the beans irrigated, but the entire 25-acre crop of unsprinkled beans was a loss.

634. RAY, V. K. How to get an irrigation loan. Ark. Farmer 57(3):8. Mar.1955. 6 Ar42
Discusses credit sources and mentions examples of profit from irrigation. Cotton yields have increased an average of 200 lb. of lint cotton to the acre for 4 years at Marianna Branch Experiment Station. Other high-cash-value crops that may be increased by irrigation are corn, up to 100 bu. per acre; alfalfa, about 10 tons per acre; returns from strawberries up to $3,000 per acre.

635. REDMAN, J. C., and ALLEN, S. Q. Economic allocation of resources to supplemental irrigation. Ky. Agr. Expt. Sta. B. 649,22 p. Aug.1956. 100 K41
Weather records at Lexington, Ky., indicate an average of 2 droughts of 16 days or longer each year since 1900. In deciding about using irrigation a farmer is faced with the same problems that occur with any other investment decision. In considering the benefits of irrigation against the costs a great many interrelated problems are encountered. In 1953, 11 farmers who irrigated tobacco in Shelby County increased their yield from 2,024 to 2,220 lb. per acre for an additional gross return of $182.10 per acre, including a price increase of $3.60 per 100 lb. In 1952 pasture yields were increased by 48 percent more cow-grazing days with irrigation. On another pasture irrigation increased yield of dry matter from 3,064 lb. per acre to 5,444 lb., and of beef from 273 lb. per acre to 429 lb. Investment and operating costs are shown for typical small, medium, and large irrigation systems.

636. ROSENKRANS, D. B. Through irrigation pipes and furrows local showers fell over Mississippi. Prog. Farmer. Miss.-Ark.-La. Ed. 69(11):24-25,30,32-33. Nov. 1954. 6 So81
Experiences of various Mississippi farmers with irrigation of cotton. One farmer irrigated 15 acres of cotton, leaving a 10-row nonirrigated check strip. The check plot yielded less than 1/2 bale per acre, while the irrigated field yielded 1 1/2 to 2 bales per acre. The plants in the check row were only knee high, while those in the irrigated rows were of normal height. Furrow irrigation was used, the water being pumped from a 12-in. well 125 ft. deep, by a 40-hp. electric pump. Two-thousand gal. of water per minute were pumped knee deep into ditches 14 ft. wide. Another farmer used a sprinkler system to irrigate 60 of his 95 acres, applying the first irrigation in late August. Even at this late date, the irrigated plot yielded 1/4 bale per acre more than did the unirrigated plot. A Delta farmer irrigated 50 acres of cotton twice with 2 in. of water each time and another 40-acre plot only once with 2 in. The double irrigation caused a yield of 1/2 to 3/4 bales per acre, compared to only 1/4 bale per acre for the single irrigation.

637. RUSSELL, H. Operation irrigation. Ark. Farmer 55(11):9,11. Nov.1953. 6 Ar42
An Arkansas farmer paid for his sprinkler-irrigation system in 1952 by using it on 30 acres of Lespedeza which produced 45 tons of hay at $45 a ton, and on 10 acres of pastures. Nineteen cows grazed on the pasture before irrigation produced 3 1/2 cans of milk per day; after irrigation milk production increased by 1 1/2 cans per week. Specific costs are not given.

638. SANDERS, C. M. Conservation irrigation design in Alabama. (Abs.) Assoc. South. Agr. Workers. Proc. 50:197-198. 1953. 4 C82

Basic factors which influence the design of irrigation systems for 2 Alabama farms are listed. To irrigate 52 acres of pasture and 5 acres of corn, costs were as follows: Well $1,500, 2 ponds $2,000, and equipment $4,500. To irrigate 160 acre of Irish potatoes, the costs were: Pond $3,000 and equipment $16,000.

639. SANDERS, C. M. Surface irrigation in Alabama. Ala. Polytech. Inst. Agr. Ext. C. 485:23-24. Aug.1955. 275.29 AL1C
Irrigation must supply the required amounts of water without waste or erosion, and must maintain and improve soil productivity. Three methods of surface irrigation that can be used successfully in Alabama are the furrow method (for row crops), and the graded, and contour border methods (for pastures and hay crops). Discusses the types of surface irrigation from an economic as well as from a technical point of view.

640. SCHALLER, J. A., and MITCHELL, N. Truck and pasture irrigation. In Johns-Manville Corporation. Supplemental irrigation, p. Ga. 9-10. New York, 1951. 55 J62
Report of a cooperative study made by the TVA and the extension services and agricultural experiment stations of Tennessee and Georgia. Irish potatoes: Irrigated plots yielded $240 per acre, compared to $132.64 per acre for unirrigated plots. With irrigation costs amounting to $11.10 per acre, net returns were $228.90 per acre — $96.26 more per acre than the value of the unirrigated crop. Sweetpotatoes: Irrigated plots yielded crops valued at $266.60 per acre, compared to $50 per acre for unirrigated crops. With irrigation costs amounting to $8.86 per acre, the net return was $257.74, or $207.75 more than the value of the unirrigated crop. The report does not discuss details of the irrigation installations, since the purpose of the study was to determine the effects of irrigation on yields. No figures are given for pasture irrigation.

641. SHIRLEY, T. Can I afford not to irrigate? Rur. Kentuckian 8(6):9,20. June 1955. 335.8 K41
Using as an example a 40-acre sprinkler system costing $3,500 ($2,600 for pipe and other equipment and $900 for a power unit), annual fixed costs will be $857.96 ($576 for power, $55.40 for repairs and maintenance, and $226.56 for labor). Total annual cost for the 40 acres will then be $1,208.79, or $30.22 per acre. The farmer must be able to increase his average yield per acre per year by at least that amount to make irrigation pay off. Cites examples of the profitableness of irrigation: Tobacco tests in Kentucky in 1951-53 reveal an average 697 lb. more tobacco can be produced per acre when irrigated, resulting in $408.17 more income; pasture tests for dairy cattle in Tennessee in 1951-54 netted 61 percent more cow days of grazing, 61 percent more milk, with a net return above irrigation and feed costs of $100.21 per acre.

642. SHUTTS, E. E. Rice irrigation in Louisiana. Amer. Soc. Civ. Engin. Proc. Sept. 156,14 p. Oct.1952. 290.9 Am3Ps
Rice production in the United States has risen from 2,908 thousands of bushels in 1839 to 70,160 thousand in 1945. About 30 percent of this production is in Louisiana and slightly less in Texas. A detailed description is given of rice irrigation in Louisiana. Ground water as well as diverted water from rivers is widely used for rice irrigation.

643. SMITH, E. V. Unsolved problems that limit the use of irrigation on Alabama farms. Ala. Polytech. Inst. Agr. Ext. C. 485:5-6. Aug.1955. 275.29 AL1C
Among the problems yet to be solved to make irrigation foolproof in Alabama are a better understanding of the consumptive use of water by various plants, particularly of forage crops, and an understanding of the relationship between kinds and rates of fertilizer in connection with irrigation.

644. SPOONER, A. E., BROWN, D. A., and WADDLE, B. A. Irrigation and fiber properties of cotton. Ark. Farm Res. 5(4):3. Winter 1956. 100 Ar42F
In tests at the Arkansas Agricultural Experiment Station in 1956, 4 irrigation treatments were tried on cotton. The treatments were: 1, No irrigation; 2, irrigation begun when the bolls were 17-22 days old; 3, irrigation begun when blooms first appeared; and 4, irrigation applied throughout the growing season. The results were as follows: Treatments 1 and 4 caused a loss of fineness in fiber, treatment 2 resulted in the greatest degree of fiber fineness; length of fiber was increased with each increase in irrigation; fiber strength was not much affected by irrigation, although the strength was greatest under treatment 2, next greatest under treatment 3, third greatest under treatment 1 (no irrigation), and least under treatment 4 (maximum irrigation).

645. SPOONER, A. E. 1956 results from soybean irrigation. Ark. Farm Res. 6(2):7. Summer 1957. 100 Ar42F
Irrigation of soybeans in Arkansas has risen from 38,000 acres in 1953 to 160,000 in 1956. Trials were set up at Stuttgart and Marianna in 1956, using no irrigation and 3 levels of irrigation. No irrigation averaged 28 bu. per acre, 2 irrigations averaged 35.7 bu.,3, 4, and 5 irrigations averaged 40 bu. per acre. The Dorman and Lee varieties were used in the trials. The Lee is a late variety and in general gave a greater response to irrigation.

646. SPOONER, A. E. Soybean irrigation in '55. Ark. Farm Res. 5(1):7. Spring 1956. 100 Ar42F
Yields as affected by periods of irrigation and inches of water. A 1-year experiment conducted at the Rice Branch Experiment Station, Stuttgart, with 3 irrigation treatments and no irrigation on 2 varieties of soybeans. All plots received uniform fertilizer treatment. Yields of both varieties were approximately doubled. The greatest yield per inch of water resulted when plants were treated with 4 1/2 in. water, and were irrigated 3 times. Dorman variety yielded 15.48 bu. per acre unirrigated, 28.31 bu. per acre irrigated. Lee variety yielded 17.14 bu. per acre without irrigation, and 36.66 bu. per acre when irrigated.

647. STRAND, A. B., and PICKETT, B. S. Irrigation and fertilization experiments with vegetables at Dandridge, Tennessee. Tenn. Agr. Expt. Sta. B. 265,7 p. Oct.1957. 100 T25S
Experiments were conducted on relatively infertile high terrace soils with tomatoes, beans, and cabbage from 1944 to 1947. Tomatoes averaged 5.4 tons when irrigated and 5.6 without irrigation; beans averaged 211 bu. when irrigated and 104 without irrigation; and cabbage averaged 14.4 tons irrigated and 6.2 without irrigation. Two of these years were considered dry and 2 were moist. Tomato response was erratic and fruit rot increased when the crop was irrigated. Fertilizer is essential on these soils even without irrigation. Generally 600 lb. of 5-10-10 or 5-10-5 gave the best response.

648. SULLIVAN, G. D., and WIEGMANN, F. H. Irrigation costs and returns for cotton in the Mississippi and Red River Delta areas of Louisiana. La. Agr. Expt. Sta. B. 512,32 p. Feb.1958. 100 L93
A survey of 71 farmers irrigating cotton in the Mississippi and Red River Deltas was made in January 1957. Size of the acreage irrigated varied from 13 to 283 acres. Thirty-nine of the farmers used flooding and 32 used sprinklers. Rainfall in 1956 was generally below average. Investment cost for sprinklers varied from $198 per acre for the farms irrigating 30 acres to $48 per acre for those irrigating 270 acres per farm. Flooding investment costs for the same sizes were $75 and $51. Using a depreciation rate of 6.7 percent and interest rate of 6 percent the fixed cost varied from $11.20 per acre for the 30 acres to $4.83 when 270 acres were irrigated. Irrigation alone needed about 2.5 additional hours of labor per acre but other added labor for extra chopping, poisoning, cultivating, and picking added about 18 additional hours per acre. Total costs of irrigation for 30 acres were $26.09 per acre for one irrigation, $38.98 for 2 irrigations, and $51.87 for 3 irrigations. On the 270-acre farms the cost was $20.65 for 1 irrigation, $36.47 for 2 irrigations and $52.29 for 3 irrigations. The increase in yield was 622 lb. of seed cotton per acre for the 30-acre farms and 844 lb. for the 270-acre farms. Net added returns were $45.63 per acre for the 30-acre farms and $75.10 for the 270-acre farms.

649. SURFACE irrigation. Farm Q. 12(2):56-59,73-74,76-78. June/Aug.1957. 6 F22995
Surface irrigation is widely used in Mississippi County, Ark. The nearly level fertile Delta land and the heavy soil make flood irrigation practical for these conditions. One grower reports cotton-yield increases averaging 200 lb. of lint cotton or about $66 gross with irrigation. In the dry years there is little doubt about irrigation paying but during the wet years the answer isn't known until the crop is weighed out at the gin. One farmer using gated pipe can irrigate 20 acres a day using 2 men for the job. One of the first essentials of flood irrigation is a careful job of leveling.

650. SWEET, F. Pasture irrigation, Tennessee. What's New Crops & Soils 5(6):21-22. Mar.1953. 6 W55
In experiments at the Dairy Experiment Station in Lewisburg, Tenn., in 1951 and 1952, the following results were achieved: In 1951, at a cost of $2.45 per acre-inch, irrigated pasture provided 48 percent more milk, 52 percent more fat, and 37 percent higher net income per acre. In 1952, at a cost of $2.54 per acre-inch, irrigated pasture provided 51 percent more cow days, 56 percent more milk, and 39 percent higher net income. The net income from milk was $388.60 per acre on irrigated pasture, and $278.55 on unirrigated, a net increase of $110.05.

651. SWINGLE, H. S. Storing water for use in irrigation. Ala. Polytech. Inst. Agr. Ext. C. 485:50-55. Aug. 1955. 275.29 AL1C
Alabama has 3 large river systems and many creeks and small streams within its borders. There are 2,822 miles of major rivers and 6,942 miles of minor rivers and major creeks. In October 1954 there were 11,852 ponds and over 241,000 acres of large reservoirs. The average rainfall is 54 in. and over one-third of this amount or 23.2 in. runs off the land. Tables are given for seepage, evaporation, runoff, water analysis, and storage.

652. TALBERT, T. J. Supplementary irrigation of horticultural crops. Tenn. State Hort. Soc. Proc. 47:14-18. 1952. 81 T25
Discusses the advantages and disadvantages of sprinkler irrigation in Tennessee. Advantages include the prevention of soil erosion and compaction, elimination of the need for land leveling, and the insurance of better quality produce for market. Disadvantages are mainly the high costs of equipment and installation. The cost of applying one acre-inch of water is from $1.50 to $2.50 including fuel, labor, depreciation, and interest on the investment. Tomatoes at the West Tennessee Agricultural Experiment Station gave a 41-bu.-per-acre increase over nonirrigated. Snap beans yielded 1,300 lb. more per acre with irrigation, and strawberry crops, which had failed completely in dry years, yielded 290 crates per acre with irrigation.

653. TAYLOR, J. C., and WOODWARD, R. S. Using irrigation for prevention of cold damage to peach blossoms. (Abs.) Assoc. South. Agr. Workers Proc. 54:200. 1957. 4 C82
A 2-acre peach orchard at Calhoun, La., was protected from a 23° freeze in March 1956 with overhead sprinklers. Temperature in the orchard was 28°. Water was applied at the rate of 1/2 in. per hour from about 3 until 7 a. m. Blossom kill was averaging 72 percent where not protected and 14.1 percent where the sprinklers were operated. Protection was complete close to the sprinklers where more complete icing was obtained.

654. TECHNICAL aid in rice irrigation. Rice J. 57(5):20-23. May 1954. 59.8 R36
The problem of alkalinity from excess irrigation was solved for an Arkansas rice and truck farmer, by experts at the Arkansas College of Agriculture. The canals leading from the well where the alkalinity originated were lengthened, and the water was passed through a settling basin long enough to allow the undesirable minerals to be precipitated from the water before it was applied to the land. The improvement in the quality of the water accounted for a 10-bu. increase per acre in yield on the 200-acre ricefield.

655. THAXTON, R. M. Irrigation on a horse breeding farm; a new method of increasing and maintaining pasture production. Blood-Horse 63:304-305. Feb.9, 1952. 42.8 T392
In "humid" Kentucky there were 13 years in a 20-year period studied in which there was insufficient rainfall for good pasture growth. In 1950 and 1951 an experiment was conducted by the Kentucky Agricultural Experiment Station, on bluegrass and white clover permanent pasture, to determine the degree of practicality of pasture irrigation. An area of .6 acres was divided into 3 equal blocks, 2 of which were irrigated after each 10-day period of less than 1 in. of rain, with 1 and 2 in. of water respectively. The third block was not irrigated. In 1950, a wet year, there was no appreciable difference in the yield of the 3 plots. In 1951, a dry year, the nonirrigated plot produced 151 lb. of dry matter per acre from July 27 through October, while the irrigated plots produced 1,930 and 2,319 lb. per acre for 1 and 2 in. of water per application, respectively. It was also found that irrigation prevented weed invasion, made nitrogen fertilization more effective, and permitted more uniform grazing.

656. THOMPSON, W. R. The South is learning that rain isn't enough! Co. Agent & Vo-Ag Teacher 10(4):20-22. Apr.1954. 275.28 N213
Rainfall records in Mississippi indicate that in 39 out of 41 years irrigation was needed at some time during the season. In 1948 tomatoes at the experiment station yielded 145 boxes or $435 when irrigated as compared to $207 or 90 boxes when not irrigated. Costs were $147.50 where irrigated and $140 per acre where not irrigated. In 1952 a Bermuda-Dallis-grass pasture yielded only 145 lb. of green matter where unirrigated and 9,189 where irrigated. Sudan and millet this same year in 3 cuttings yielded 26,219 lb. of green matter per acre where unirrigated and 73,557 lb. where irrigated. Sorghum for silage yielded 46,199 lb. where irrigated and 36,078 lb. per acre where unirrigated. Corn for silage yielded 31,765 lb. per acre where it was irrigated and 14,661 lb. where it was unirrigated.

657. TRAMEL, T. E., CROWE, G. B., and ABEL, J. F. Supplemental irrigation, investment and operating costs in the Delta area of Mississippi. Miss. Agr. Expt. Sta. B. 559,27 p. May 1958. 100 M69
A summary of 145 farms in the Mississippi Delta shows an average investment of $73 per acre for sprinklers, $57 for gated-pipe systems, $36 for siphon-tube systems, and $50 for other gravity systems. Surface sources of water are used where it is convenient but wells are more common in this area. They are dependable and are not expensive. It is possible to develop and equip a well for $5,000 that will deliver 2,000 gal. per minute. Annual pumping costs will average about $.45 per acre-inch. Annual operating costs per acre averaged $15 for all systems. Sprinkler systems averaged $18, gated-pipe $18, siphon-tube $8, and other gravity systems $12.

658. VAILE, J. E. Irrigating strawberries pays. Ark. Farm Res. 4(2):2. Summer 1955. 100 Ar42F
Studies carried out at the Arkansas Strawberry Substation in 1953 and 1954 showed results as follows: Average yield in 1953 was 32 crates per acre more from irrigated than from unirrigated plots; average yield in 1954 was 46 more crates per acre from irrigated plots; the 2-year average yield was 175.9 crates per acre per year from irrigated plots, 137 crates per acre per year from unirrigated crops. Allowing $6 net per crate above all costs other than irrigation, the increase in yield due to irrigation amounted to a return of from $200 to $250 per acre per year.

659. VAILE, J. E., and MCDANIEL, A. T. Irrigation of strawberries; influence on development of beds and on yields. Ark. Agr. Expt. Sta. B. 568,15 p. Mar.1956. 100 Ar42
Two varieties of strawberries were used in Arkansas irrigation trials from 1952 to 1954. The first year was a reasonably moist year and the latter 2 years were considered very dry. In 1952 the average yield was 81.4 crates per acre from the unirrigated, 84.6 crates when irrigated at the 20-percent level, and 71.3 crates when irrigated at the 50-percent level. This was for the Blakemore variety and it averaged for the 3 years 137 crates on the unirrigated, 175.4 crates on the 20-percent level, and 176.4 crates on the 50-percent level of irrigation. The Tennessee Beauty variety was lost in 1953 because of flooding at harvesttime. For the 2 years the average yield

was 93.7 crates without irrigation, 127.2 crates when irrigated at the 20-percent level, and 110.6 crates when irrigated at the 50-percent level. Optimum for strawberries appears to be maintaining the moisture above the 20-percent level.

660. VAN HORN, A. G., and others. Irrigation of pastures for dairy cows. Tenn. Agr. Expt. Sta. B. 248, 19 p. June 1956. 100 T25S
W. M. Whitaker, R. H. Lush, and J. R. Carreker, joint authors.
Irrigation studies 1951-54 on orchardgrass-Ladino-clover pasture at the Dairy Experiment Station, Lewisburg, Tenn. Results show average cost of $50.21 per acre for an average of 19.39 in. of irrigation water applied. The largest item in the cost ($21.14) was for setting up irrigation equipment and moving pipes. Irrigated pasture produced 61 percent more grazing as indicated by calculated yields of TDN, and 58 percent more milk than the unirrigated pasture. Income from the sale of milk from the irrigated pasture after deducting cost of supplemental feed and cost of irrigation averaged $99 per acre above the income from unirrigated pasture after deducting cost of supplemental feed. Tables also give figures in terms of pounds of TDN, milk, and butterfat, and of milk production per acre.

661. VAN HORN, A. G., and LUSH, R. H. Water on pasture boosts milk output. Tenn. Farm & Home Sci. 2:6,10. Apr./June 1952. 100 T25F
Experiments with pasture irrigation at the Tennessee Dairy Experiment Station in 1951 are described, and costs and results are summarized. A total application of 24.33 in. of supplementary water per acre cost $59.67 per acre ($2.45 per acre-inch), including $25.16 for labor, $13.09 for fuel, $7.38 for repairs, and $14.04 for depreciation of equipment. Cows on irrigated pasture gave 48 percent more milk than cows on unirrigated pasture, and, due to the improved quality of the milk, its dollar value was 55 percent higher. Net income from irrigated pastures was $447.76 per acre, compared to $326.76 from unirrigated pastures, or a net profit of $121 per acre.

662. WALKER, W. K. Drought solver: Supplemental irrigation. Livestock Wk. 7(39):21. July 30,1953. 49 L753
Experiences of a Gladiolus nurseryman in Tennessee. The initial cost of a sprinkler system was $6,000, of which $4,000 was for pipes, $500 for sprinklers, and $1,500 for pump and motor. He figured an annual cost on equipment of $2 per acre per 2-in. application. Labor was $.60 per acre per 2-in. application, and fuel came to $.70 per acre per 2-in. application, or a total annual cost of $3.30 per acre per application.

663. WARE, L. M. The effects of fertilizers, organic material, and irrigation on the yield of certain truck crops. (Abs.) In Johns-Manville Corporation. Supplemental irrigation, p. Ala. 1. New York,1951. 55 J62
Experiments at the Alabama Agricultural Experiment Station in 1939 and 1940 showed that while irrigation and organic fertilizer used separately resulted in some increases in yields, it was only when the 2 were used together that maximum increases were obtained. In 1939 the yield of potatoes increased 69 percent with 1,000 lb. of organic fertilizer plus 2 applications of supplemental irrigation. In 1940, irrigation alone gave no appreciable increase in the yield of potatoes, organic matter alone resulted in a 134-percent increase, and a combination of the 2 treatments gave a 274-percent increase. Fall crops were more affected by irrigation than were spring crops. In the dry fall of 1939 the turnip yield increased 7,080 lb. with irrigation, 2,645 lb. per acre with organic matter, and 16,210 lb. per acre when both irrigation and fertilization were applied.

664. WARE, L. M., and JOHNSON, W. A. Effects of irrigation and other practices on sweet corn. Amer. Soc. Hort. Sci. Proc. 55:416-422. June 1950. 81 So12
Four years of experiments with different combinations of fertilizer, organic materials, and irrigation have been conducted at Auburn, Ala. Organic matter gave increases in yield and grade as much or more than irrigation, but combinations were even more effective. Yields were increased from 400 to 667 to 787 to 1,773 doz. ears per acre as animal manure, manure and vetch, and irrigation were successively added. Additional fertilizer is definitely needed with irrigation on most vegetable crops.

665. WARE, L. M. Irrigation along with other good practices pays off with vegetable crops. Atlantic Coast Line Agr. & Livestock Topics 6(5):1-2. May 1954. 6 At63
The Agricultural Experiment Station, Auburn, Ala. presents discussion and tables giving dollar value of increased yields from 2 crops grown in succession on the same land the same year. Irrigation, organic materials, and fertilizer were used separately and in combination of twos and threes. Experiments covered 11 years and were on 3 spring and 4 fall crops. Results indicate that the value of the 3 good cultural practices used together is greater than each used separately: Bush beans, the value was increased from an average of $135 per acre to $468; cabbage, from $13 per acre to $406; and fall lettuce, from $80 per acre to $853. Under certain conditions some crops respond differently, and show a lower value when organic materials are used with irrigation than with irrigation alone.

666. WARE, L. M. Review of irrigation research on horticultural crops in Alabama. Ala. Polytech. Inst. Agr. Ext. C. 485:10-15. Aug.1955. 275.29 AL1C
In experiments with 22 vegetable crops over the years from 1938 to 1954 at the Alabama Agricultural Experiment Station, irrigation increased yield 70 percent of the time, had no appreciable effect on yield 17 percent of the time, and decreased yield 9 percent of the time. Yield increase due to irrigation alone averaged 12 percent for spring crops, 35 percent for summer crops, and 54 percent for fall crops. Irrigation plus added organic matter increased yields 36 percent for spring, 56 percent for summer, and 54 percent for fall crops. In all trials, as greater and greater selectivity of crops and practices was used, except for the use of organic matter, the value of irrigation increased progressively from $78 to $92 to $136 to $173 to $461 per acre. When organic matter was added to all other practices the increases from irrigation were $84, $133, $193, $279, $570, and $1,062.

667. WARE, L. M. Some observations on irrigation. Mkt. Growers J. 82(5):30-31. May 1953. 6 M34
Fifteen years of irrigation research at the Alabama Agricultural Experiment Station resulted in the following findings: 1, The average values of increased yields were $150 per acre for fall vegetables, $103 for spring vegetables, and $44 for summer vegetables; 2, while the average increase, through irrigation, in years of favorable rainfall was only $158 per acre, it was $296 per acre in dry years; 3, irrigation combined with 400 lb. of fertilizer per acre increased yield value by $16, combined with 800 lb., by $103, and combined with 1,200 lb., by $205; 4, when fertilizers, manures, and irrigation were combined, the yield value was $907 per acre, compared with $574 per acre when the 3 treatments were used separately.

668. WARE, L. M. Supplying optimum conditions for truck crops in the South. In Johns-Manville Corporation. Supplemental irrigation, p. Ala. 8-9. New York,1951. 55 J62
Studies on corn growing in the South at the Alabama Agricultural Experiment Station gave results as follows: When a commercial fertilizer alone was added, a corn crop valued at $153 per acre was obtained; when a commercial fertilizer and manure were added, the crop was valued at $439.50 per acre; when a commercial fertilizer and manure were added, and the crop was irrigated, the crop had a value of $553 per acre; and when all of these factors were applied to a crop grown on a crop of turned vetch, the resultant crop had a value of $699.50 per acre.

669. WARE, L. M., and JOHNSON, W. A. Value of irrigation with different fertility treatments for vegetable crops. Ala. Agr. Expt. Sta. B. 276,69 p. Ref. June 1950. 100 AL1S
Results of irrigation studies with vegetable crops extending over 11 years. Two aspects of the study were to measure the effects of irrigation with and without other practices, and to obtain data on costs, and returns from production. It was found that irrigation combined with organic materials increased yields for all crops an average of $185.98 per acre, with a rise to an average increase of $266.45 per acre in drier years. Irrigation alone increased the yield of corn by 307 doz. ears per acre, increased the percentage of marketable ears from 38 percent to 57 percent, and increased the weight from 6.51 lb. per doz. to 7.38 lb. per doz. Irrigation combined

with organic materials increased yield by 507 doz. ears, marketable percentage to 76, and weight to 9 lb. per doz. The average cost of the irrigation was $5.56 per acre-inch.

670. WARE, L. M. The value of organic matter and irrigation in the production of potatoes in Alabama. *In* Johns-Manville Corporation. Supplemental irrigation, p. Ala. 3-7. New York,1951. 55 J62

Experiments at Alabama Agricultural Experiment Station in 1940-42, indicate that irrigation has more effect on fall crops than on spring crops. The yield of fall potatoes receiving different rates of chemical fertilizers, different types of organic matter, and none or only 1 acre-inch of irrigation, is shown in tables. The highest average yield for the 3 years was 128 bu., when 1,500 lb. of 6-8-4, 12 tons of manure plus vetch turned under, and 1 acre-inch irrigation were applied. The next highest average of 118 bu. per acre resulted from the same organic fertilization and the same amount of supplemental water, but with only 1,000 lb. of 6-8-4. The above rate of both organic and chemical fertilization, but with *no* irrigation, resulted in a yield of only 52 bu. per acre.

671. "WE SAVED our crops!" Amer. Veg. Grower 1(8):9,17. Aug.1953. 80 C733

Experiences of Mississippi and Arkansas farmers. In the drought of 1952, a Mississippi farmer irrigated part of his 35-acre cornfield. The unirrigated part died before bearing, while the irrigated part averaged 80 bu. per acre. Another Mississippi corngrower produced 87 bu. per acre after just one irrigation, while neighboring unirrigated farms suffered complete crop failures. A Mississippi cabbage grower, after irrigating, harvested 14 tons of cabbage per acre, for a gross return of $2,000 per acre. An Arkansas farmer irrigated snap beans at the blooming stage and each week thereafter when the temperature was 100°, and grossed $587 per acre on the crop. The same farmer, later threatened with a crop-killing frost, used his irrigation system to save most of his 11 acres of beans. Though some were killed by frost, he managed to save enough to harvest 18 tons of beans from the 11 acres.

672. WELCH, E. G. Irrigation in Kentucky. Ky. Agr. Col. Ext. C. 528,24 p. Feb.1955. 275.29 K415

Discusses irrigation of corn, alfalfa, pasture, truck crops, berries, and tobacco, costs of irrigation, selection of equipment, pumps, sprinklers, application, etc. Reports also on a study of 10 tobacco farms in normally wet Shelby County where supplemental irrigation involved an initial investment of $2,500 per farm plus $2,000 for the construction of a reservoir. The average total cost of irrigation on an investment of $4,500, including interest, depreciation, labor, taxes, and operating expenses was $22.94 per acre per year. Irrigated land yielded an average of 172 lb. more tobacco per acre than unirrigated, and the tobacco sold for an average of $3.49 more per 100 lb. Deducting the cost of irrigation, this meant an increase in net income of $155.09 per acre.

673. WELCH, E. G. Tobacco irrigation in Kentucky. Ky. Farmer 88(9):4,34. Sept.1952. 6 F2237

In 1951 farmers, county agents, irrigation companies, and extension agricultural engineers cooperated in collecting data from 11 different farm demonstrations in Kentucky. Nonirrigated check plots were used in some demonstrations. Irrigated and nonirrigated tobacco averaged 2,081 lb. and 1,493 lb. per acre, and sold for $1,273.47 and $820.35 per acre, respectively.

674. WHITE, J. H. Sprinkler irrigation in eastern Arkansas; needs for irrigation; costs in 1955. Ark. Agr. Expt. Sta. Rpt. Ser. 62,15 p. Dec.1956. 100 Ar42R

Weather records at several stations in eastern Arkansas show an average of 2.6 periods of 14 or more days without appreciable rainfall each year. In 1955 costs of sprinkler irrigation were obtained from 22 farmers. Each farmer averaged 94 crop acres irrigated 1.57 times. Investment averaged $6,616 per farm or about $70 per acre irrigated. Fixed costs per acre were $7.09 and variable costs were $3.13 per acre for a total annual cost of $10.22 per acre irrigated once, or about $4.65 per acre-inch of water applied.

675. WHITE, J. H. What does gravity irrigation cost? Ark. Farm Res. 6(2):3. Summer 1957. 100 Ar42F

A survey of 41 Arkansas farmers using surface or gravity irrigation was made in 1956. This method is the most commonly used method in Arkansas even when rice irrigation is omitted. Total investment per farm including the well, pump, power unit, and other irrigation equipment was $2,696 for those using tractor power, and $3,804 for those using industrial power units. Operating costs were $3.22 per acre irrigated 1 time for tractor-powered units, and $2.02 per acre each time for those using industrial engines. In 1955 an average of 47 acres was irrigated 4 times, and in 1956 the average was 81 acres irrigated 2 times for each well. Tables are given for each source of power for different acreages and numbers of irrigations showing costs per acre.

676. WIEGMANN, F. H., and KOCH, K. A. Now take Louisiana, for instance. Irrig. Engin. & Maintenance 6 (3):15,44. Mar.1956. 55.8 Ir722

In the 27 parishes of northern Louisiana, irrigation increased from a total of 12 farms in 1949, to 466 farms in 1955. In 1949 the total irrigated acreage was 566, while in 1955 it was 39,610. Most of the irrigation was of row crops such as corn and cotton, although some pastures were irrigated.

677. WIEGMANN, F. H., and BOLTON, B. A preliminary discussion of crop irrigation in Louisiana. La. Rur. Econ. 16:1,4-7. Feb.1954. 281.8 L93

The acreage of farmland irrigated in Louisiana increased from 13,603 in 1950 to 21,532 in 1953. Of the latter figure, 12,405 acres were in crops, and 9,127 were in pasture. Rice irrigation had been a necessary cultural practice in Louisana for many years, but recently the practice has been applied to vegetables, fruit, cotton, corn, and sugarcane. Both sprinkler and flood irrigation are employed, in about equal proportions. In the flooding system, the principal investment costs involve land grading and leveling, and the construction of ditches and drains. With sprinkler irrigation, the equipment itself constitutes the greatest expense. Of the 21,352 acres irrigated in 1953, water was supplied from streams in the case of 14,221 acres, from wells for 4,040 acres, and from farm ponds for 3,091 acres. The feasibility of irrigation, financing systems, need for further research into the benefits of irrigation for some crops, and possibility of the creation of further surpluses through irrigation, are also discussed.

678. WIEGMANN, F. H., and KOCH, K. A. Trends in irrigation in Louisiana. La. Agr. Expt. Sta. DAE C. 187, 17 p. Mar.1956. 100 L935

Acreage, types of farms, methods, source of water, and areas of new development are given. This is the result of a survey of parish agents and does not include acreage of rice and strawberries that are irrigated. Acreage reported for the various regions was 21,496 in 1953, 31,547 acres in 1954, and 52,095 acres in 1955. Most of the increase is in cotton, corn, and pasture. About a third of the increase is sprinkler irrigated while the rest is by flooding. Most of the new irrigation is in northern Louisiana.

679. WIEGMANN, F. H. Water resource problems and irrigation in Louisiana. La. Rur. Econ. 17(3):4-5,8. Aug.1955. 281.8 L93

Louisiana recognizes the "riparian rights" doctrine. That is, any farmer bordering a stream may use the water for irrigation purposes. Thus there is no limit to the number of farmers who may draw on the water, with the result that the original irrigator may find himself with insufficient water to operate his expensive equipment. To solve the problem, it is recommended that a "prior appropriation" doctrine be substituted for the present "riparian rights" doctrine.

680. WINDHAM, S. L., BLACKWELL, C., and MOORE, E. L. Higher yields of sweet corn from irrigated plots. Miss. Farm Res. 15(3):1,8. Mar.1952. 100 M69Mi

Experiments at the Mississippi Truck Crop Branch Station in 1951, with the effects of fertilization, spacing, and irrigation on corn, gave the following results in part: Optimum yield of marketable ears was produced when 500 lb. of 6-8-8 and 64 lb. of nitrogen were applied to plantings of 24,891 to the acre, and when irrigation was employed. This combination produced 1,344 doz. marketable ears per acre, compared with only 403 doz. for plots similarly spaced and fertilized when irrigation was not used. The longest ears were produced when 500 lb. of 6-8-8 and 32 lb. of nitrogen were applied to plantings of 16,830 to the acre, and when irrigation was used. This combination produced ears averaging 9.04 in., compared to ears of 8.08 in. when no irrigation was used.

681. WYLIE, C. E., NEEL, L. R., and SCHALLER, J. A. Irrigated pasture for dairy cows. In Johns-Manville Corporation. Supplemental irrigation, p. Tenn. 5-8. New York, 1951. 55 J62
Experiment conducted at the Tennessee Agricultural Experiment Station. Total rainfall for the grazing season was 12.46 in. An unirrigated pasture grazed 4 cows in the season; the irrigated pasture, receiving a total of 23 in. of added water, grazed 6 cows during the same period. Good pasture days numbered 143 on the irrigated pasture, and 82 on the unirrigated. Days in milk on the irrigated pasture numbered 1,445; on the unirrigated, 917. Total milk was 13,973 lb. on the irrigated pasture; 10,675 lb. on the unirrigated. Total fat: 756.63 lb. on the irrigated pasture; 599.59 lb. on the unirrigated. Total feed costs: $78.21 (including $48.66 as cost of irrigation) for the cows on the irrigated pasture; $26.28 for the cows on the unirrigated pasture. Total income above feed cost: Irrigated pasture, $288.33; unirrigated pasture, $262.87. Net profit: $25.46.

682. ZERFOSS, G. E. Irrigation studies. (Abs.) Assoc. South. Agr. Workers. Proc. 47:36-37. 1950. 4 C82
Presents recent results of irrigation studies conducted by the Tennessee Valley Authority, and several land-grant institutions and experiment stations in the Southeast. The University of Tennessee's Dandridge Station produced increases in yields of bush beans and cabbage from 50 to 300 percent with irrigation and other cultural benefits. Under irrigation, increases from 12 to 78 percent were obtained from bush beans and turnip greens in 1949. In one experiment the fourth cutting of alfalfa hay when irrigated produced an average yield of 1.03 tons per acre as compared with the average yield from the unirrigated area of .20 tons per acre.

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